ATTACHMENT A

A-1 Area of Review Methods
A-2 Groundwater Modeling Report
A-3 Aquifer Testing Report, Excelsior Mining Arizona, Inc.

ATTACHMENT A-1

AREA OF REVIEW METHODS

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1. INTRODUCTION

This Attachment was prepared in support of Excelsior Mining Arizona, Inc.'s (Excelsior's) Underground Injection Control (UIC) Permit application to the United States Environmental Protection Agency (USEPA). Excelsior is applying for an area Class III UIC permit to install a wellfield for in-situ recovery (ISR) of copper at the Gunnison Copper Project (Project), located in Cochise County, Arizona. The wellfield will consist of Class III delivery (injection) and recovery wells, hydraulic control wells, and observation wells. A sulfuric acid solution will be delivered to the copper oxide deposit, and pregnant leach solution (PLS) will be pumped from the recovery wells and routed to a solvent extraction/electrowinning (SX-EW) plant where copper cathode will be produced.

This attachment identifies the proposed Area of Review (AOR) as required by §146.6.

The AOR for the wellfield described in this Attachment was determined by the construction of a numerical groundwater model to determine the "zone of endangering influence", which is described in §146.6(a)(1)(ii) as follows:

> *. . .the project area plus a circumscribing area the width of which is the lateral distance from the perimeter of the project area, in which the pressures in the injection zone may cause the migration of the injection and/or formation fluid into an underground source of drinking water.*

The intent of the AOR requirement is to protect underground sources of drinking water (USDWs). UIC regulations require the permitting authority to determine, within an AOR, whether a proposed injection operation has a potential for contaminating underground sources of drinking water through wells, faults, or other pathways that penetrate an injection zone. The AOR, also known as the zone of endangering influence, is the area surrounding an injection well or injection well pattern in which the pressure change in the injection zone, resulting from high pressure injection, is great enough to make possible the migration of fluids out of the injection zone and into an underground source of drinking water (Engineering Enterprises, 1985).

2. PROJECT DESCRIPTION

2.1 Location

The Project is a proposed copper mine that will be located in Cochise County, Arizona, approximately 62 miles east of Tucson and 17 miles west of Willcox (Figure A-1). The location is along Interstate 10 on the southeastern flank of the Little Dragoon Mountains, in the Cochise Mining District. The deposit was previously known as "the I-10 Deposit" (Kantor, 1977).

The Project is located in a district where copper, zinc, silver and tungsten mining have occurred since the 1880s. The deposit was discovered in the 1960s, when exploratory drilling was conducted following detection of a magnetic anomaly. Several million tons of low-grade acid soluble copper mineralization were identified by early 1974. Since that time, extensive exploration has occurred, including 55 diamond coreholes drilled between 2010 and 2014 (M3, 2014 and 2016).

With the exception of mineral exploration and related investigations, past use of the site has been limited to livestock grazing. Interstate 10 crosses the Project from southwest to northeast; otherwise the land is vacant, as shown on a recent aerial image of the site (Figure A-2). No mining has occurred at the Project site. However, the Project does fall within an active mining district. The Johnson Camp Mine (JCM), owned by affiliate company Excelsior Mining JCM Inc. is located 1.5 miles to the northwest.

2.2 Mining Method

The Project consists of a copper mine that will encompass an area of approximately 700 acres. Within this area, copper will be extracted using the ISR method from oxide mineralization located along fractures within the deposit. The wellfield will have an area of approximately 192 acres (Figure A-3).

The ISR method involves injecting low-pH barren solutions (raffinate) into the orebody through an array of injection wells and extracting copper-bearing solutions (pregnant leach solution or PLS) though an array of interspaced recovery wells.

ISR is the preferred mining method for the deposit due to the fractured nature of the host rock, the presence of water-saturated joints and fractures within the ore body, and copper mineralization that preferentially occurs along fracture surfaces. The in-situ method avoids the challenges of open pit mining in an area with basin fill overburden thickness exceeding 400 feet

(M3, 2014) and greatly simplifies reclamation and closure because there will be no open pit, waste rock stockpiles, or tailings impoundments.

2.3 Life of Mine and Proposed Operation Schedule

The anticipated operational life of the Project is 23 years. Operations will begin upon acquisition of all necessary permits. The target start date is mid 2018.

Mine operations will be implemented in stages:

- Stage 1 — Years 1 – 10 — 25 million lbs Cu per year
- Stage 2 — Years 11 – 13 — 75 million lbs Cu per year
- Stage 3 — Years 13 – 20 — 125 million lbs Cu per year
- Post production — Years 20 – 23 — -

Multiple mining blocks will be active during each stage. As mining of individual blocks is completed, the mining operations will be followed by a rinsing period while mining proceeds to subsequent blocks. The final rinsing period for the last mining block is anticipated to be completed by year 23. A more detailed description of the rinsing for closure strategy is provided in Attachment H-2.

2.4 Process Description and Layout

The Project will consist of a network of injection wells used to deliver acidified raffinate to the ore horizon, enabling it to contact the mineralization within the fractures, and dissolve the metal while passing through the ore body. Injection and recovery wells will be interspaced approximately 71 feet apart in an alternating and repeating pattern throughout the well field. In addition, the ISR wellfield will be bounded in downgradient areas by a series of hydraulic containment wells that will provide net positive pumping for the Project. Hydraulic containment will be maintained throughout the life of the Project.

At the surface, copper will be removed from the extracted pregnant leachate solution (PLS) at a solvent extraction-electrowinning (SX-EW) plant (initially at the JCM and later at the Project site) where pure copper cathode will be produced. After processing, the fluid will be recycled to the wellfield to begin the leaching cycle again.

The locations of the Gunnison site facilities are shown on Figure A-3. Impoundments and the SX-EW plant at the JCM (owned by an affiliate company) will also be used to store and process Project solutions[1].

Additional information regarding the mining processes is included in Attachments H and K.

[1] JCM operates under Aquifer Protection Permit P-100514. There will be no ISR operations at JCM.

3. HYDROGEOLOGIC AND OPERATIONAL CONSIDERATIONS

Control of injected solutions, and thus the delineation of AOR, will rely on the wellfield's site-specific hydrogeologic characteristics and operational controls. Therefore, these considerations are presented in this section. Site-specific characteristics were considered in determining the amount of engineered and operational containment that is needed for effective operation of the wellfield. These elements constitute the Best Available Demonstrated Control Technology (BADCT) proposed in Excelsior's Aquifer Protection Permit Application for the wellfield.

3.1 Site Specific Characteristics

Site specific factors at the Gunnison site are favorable for maintaining control of the leach solution. Three factors of particular note are:

- Absence of a significant thickness of saturated basin fill overlying the zone of injection,
- Low hydraulic conductivity sulfide ore body underlying the zone of injection,
- Large attenuation capacity of limestone downgradient of the zone of injection.

Each of these characteristics is discussed in the sections below.

3.1.1 Basin Fill Saturation

The absence of a significant thicknesses of saturated basin fill overlying the proposed in-situ wellfield is a particularly favorable site specific characteristic for maintaining discharge control. Occurrences of saturated basin fill are relatively thin and isolated above the ore deposit. Saturated basin fill has been observed in only two wells that are screened solely in basin fill: NSH-006 and NSD-020. Figure A-3B shows a north-south cross section through the wellfield and the interpreted extent of saturated basin fill based on this elevation.

More information regarding occurrences of groundwater in basin fill is provided in Attachments D and S.

3.1.2 Low Conductivity Sulfide Zone

The bedrock sulfide zone is located beneath the zone of injection (i.e. the oxide zone). The sulfide zone is less fractured than the oxide zone. Excelsior conducted two aquifer tests, at NSH-014B and NSH-025, in the sulfide zone in 2015. Both tests were terminated before the scheduled end because the wells were pumped dry. A complete analysis of the aquifer testing data is provided in Attachment A-3. Drawdown in NSH-014B was 442 feet after 1.5 hours at a pumping rate of one gpm. The estimated hydraulic conductivity (K) for NSH-014B is 0.001 ft/day. Drawdown in NSH-025 was 220 feet after one hour with pumping at a rate of four gpm. The estimated K in NSH-025 is 0.03 ft/day. Both K values derived for the sulfide zone are very low.

Another indication of poor hydraulic communication between the oxide zone and the sulfide zone is the delay in the onset of recovery when wells in the oxide zones were pumped, while drawdown observation was conducted in the sulfide zone. Specifically, NSH-025 was used as an observation well during aquifer testing of NSH-019, NSH-021C, NSH-023 and NSH-024. In all these four tests, NSH-025 responded by commencing to recover up to 7.5 hours after the test pump was shut down. This time-shift is characteristic of hydrostatic relaxation as a result of dewatering of overlying aquifer, rather than a response in a confined aquifer, which propagates instantly from well to well when they are installed in the same unit. Two of these responses are shown in Figure 106 in Attachment A-3. Note that the shape of the drawdown and recovery curve does not resemble the typical “shark fin”, peaking when the pump is stopped with a sharp drop. Because these tests do not meet the assumption of AQTESOLV that the observation and the pumping well are completed in the same aquifer, these data has been omitted from the permit application.

The upper 200 feet of the sulfide zone is included in the aquifer exemption zone. While the hydraulic conductivity in the sulfide zone is low, as discussed above, the possibility that fracture connections exist between the oxide and sulfide zones cannot be ruled out.

3.1.3 Attenuation Capacity of Limestone

The regional hydraulic gradient (Figure A-4) indicates that if hydraulic control around the in-situ wellfield were to be lost, the PLS would migrate in an eastward direction. As shown on Figures A-5 and A-6, the Escabrosa and Horquilla limestones (shown as Paleozoic/Mesozoic undivided on the cross sections) are located east of the mineralized rocks. These formations are predominantly composed of calcite with some minor subordinate clastic and dolomitic beds in the Horquilla and a dolomitic layer at the base of the Escabrosa (Cooper and Silver, 1964).

Geochemical modeling by Duke HydroChem (Attachment H-2) demonstrates that the attenuation capacity of these limestones is a significant discharge control. According to Duke HydroChem, “the neutralization reaction occurs very quickly with pH of the solution reaching circumneutral within approximately one day. As the pH approaches circumneutral, metal concentrations are controlled by precipitation of secondary mineral phases and through sorption on the surface of secondary hydrous ferric oxide (HFO) precipitates.”

3.2 Operational Controls

3.2.1 Hydraulic Gradients

Excelsior's strategy for controlling solutions is to install hydraulic control (HC) wells that will generate overlapping cones of depression, where needed, around the perimeter of the wellfield.

Numerical groundwater flow (MODFLOW) and particle track (MODPATH) modeling of the Project (Attachment A-2) have shown that this approach will be successful in providing hydraulic capture and containment of the solutions. The model was constructed using aquifer parameters that were consistent with the results of numerous long-term aquifer tests conducted at the site (Attachment A-3). The model simulations were based on the operating conditions over the duration of the Project, whereby the total rate of pumping from the in-situ recovery wells and hydraulic control wells will be adjusted and maintained to exceed the total rate of lixiviant injection.

In accordance with the model findings, Excelsior will install hydraulic control wells and observation wells around the eastern, southern, and northern boundaries of the wellfield (Figure A-7). The well locations are approximate; the actual locations will be determined by site-specific conditions and the progression of in-situ mining activities. Installation and startup of the hydraulic control wells will proceed approximately concurrently with the development and startup of each in-situ wellfield block. The hydraulic control wells will be installed and operated downgradient from areas of the in-situ wellfield as those areas become active, as indicated by the Figure 52 in the Hydrogeologic Model Report (Attachment A-2).

The hydraulic control wells and observation wells will be screened (or open) at approximately the same elevations as the injection and recovery wells. The hydraulic control wells will supply water to the site and generate cones of depression which will provide an outer hydraulic barrier around the in-situ leaching operations. The observation well pairs will be located outside the hydraulic control wells and will be used to monitor the inward hydraulic gradients generated by the hydraulic control wells. Numerical modeling has shown that hydraulic control wells are not needed on the western side of the wellfield due to the higher natural west-to-east hydraulic gradient (as show on Figure A-4), with the exception of two locations where modeling indicated a localized southward flow direction. Hydraulic capture is discussed further in Attachment A-2.

Hydraulic control will be demonstrated by an inward hydraulic gradient rather than a fixed or defined amount of net extraction at the HC wells. This is appropriate, because if observation wells are in a high conductivity zone, the gradients will be low and HC pumping may need to be increased to maintain the inward gradient. Conversely, if the observation wells are in a low conductivity zone, gradients will be higher and pumping rates can be lower. A set amount of overpumping could result in insufficient hydraulic control pumping in high conductivity areas or too much drawdown due to pumping in low hydraulic conductivity areas.

HC pumping will gradually ramp up as mining proceeds and new HC wells are added. Over-pumping (or net extraction), represented by the HC wells will therefore vary as indicated in Table 13 of Attachment A-2. The performance of the HC system will be measured/confirmed using the observation well pairs installed adjacent to some of the HC wells. The observation wells will be used to measure the magnitude of the inward gradient to the HC wells. The minimum inward gradient is proposed to be 0.01 ft/ft. This inward gradient is the best indicator of the successful operation of the HC system to contain the migration of mining solutions. Therefore, Excelsior proposes to use daily measurements of the hydraulic gradients toward the HC wells to demonstrate hydraulic control, not rates of hydraulic control pumping. As a starting point, Excelsior proposes to initially pump the HC wells at a combined rate equivalent to one (1) percent of the total injection rate. If this rate results in an excessive gradient at observation wells adjacent to one or more HC wells, Excelsior will inform EPA and reduce pumping rates at these specific HC wells to a level needed to maintain an inward hydraulic gradient of 0.01 ft/ft or greater. Similarly, if the initial pumping rate at individual HC wells does not induce an inward hydraulic gradient of 0.01 ft/ft, pumping at those HC wells will be increased.

Overall, this method of operating the wellfield will result in a net withdrawal and a drawdown centered on the wellfield that will grow with time, eventually resulting in a drawdown of over 40 feet. This method of operating the wellfield maintains capture as demonstrated by the model and as verified through water level measurements of observation well pairs. It also minimizes dewatering, conserves the water resources, builds in flexibility and allows for site-specific capture should high-permeability faults be intersected.

3.2.2 Intermediate Monitoring Wells

As indicated in Figure A-8, attached, Excelsior will operate a network of intermediate monitor wells (IMWs) that includes existing wells along the western boundary of the wellfield. The IMW system will serve as a real-time early warning system to ensure the appropriate hydraulic control wells are installed and operating during mining. The IMW system includes an inner and an outer ring of monitoring wells that expand as mining operations expand. IMW's will be monitored for specific conductance and water elevation. All wells designated as intermediate monitor wells (IMWs) will be fitted with a transducer that will measure both water levels and specific conductance at least once daily. The specific conductance/water level probe will be vertically situated in the middle of the open borehole. One probe is considered sufficiently representative for the following reasons:

- Due to the high degree of connection within the fractured ore body, as demonstrated by aquifer testing, there will not be a high degree of stratification of water quality within the ore zone. The groundwater/PLS mixture will be well mixed.
- IF there are any differences in water quality within the borehole, mixing within the borehole through diffusion will occur.
- The inner ring is primarily for operational use, allowing operators to observe the immediate effects of changes in operational conditions like injection or recovery rates. Some mining solutions are expected to be observed in these wells due to the sweep of solutions in and out of the margins of the active mining blocks. This is expected and a function of the mining method.

The outer ring will serve as an early warning system to ensure the appropriate hydraulic control wells are installed and operating. Alert levels for specific conductance will be set in the outer ring of IMW's. Increasing trends above alert levels in outer wells would illicit responses as described in Section 2.5.4 of Attachment P.

The location of the outer IMW's for Stage 1 is based on the aquifer testing that has already been completed in the proposed Stage 1 mining area. This aquifer testing shows the degree of connectivity between the pumping well and the surrounding observation wells. Figures A-9, A-10, and A-11 show the areas of influence of NSH-013, NSH-021C, and NSH-024, which are located within Stage 1 operations. The shaded areas represent the interpreted areas of influence, based on responses in observation wells. The composite area of influence of these three wells, as shown on Figure A-12, covers all of Stage 1. Figures A-9, A-10 and A-11 provide cross sections through each of the tested wells (NSH-013, NSH-021C, and NSH-024). The intent of the cross-sections is to show how the fault network at the site results in hydraulic connections over long distances. Bedding plane fractures, which are shown as dipping to the east, are lesser, but significant flow paths.

The general principle is to locate outer IMW's along the more conductive fluid pathways (bedding-parallel and structures), at distances of several hundred feet from the active mining area, in a radial pattern spatially distributed and surrounding the mining area. Regardless of the IMW's exact location, the aquifer test results show that all the structures are hydrologically well connected, and as long as the IMW intersects either a structure or bedding parallel feature, it should respond to and detect potential migrations outside the active mining area in that direction.

IMWs will consist of existing core holes, observation or aquifer test wells, supplemented where considered necessary by additional wells to be drilled. Figures A-13, A-14, A-15, and A-16 show proposed IMW's for Year 1, Year 5, Year 10, and Year 13 respectively. Figure A-17 shows cross sections through Stage 1 blocks, showing the IMW locations and the significant structures that they intersect. Given the spacing and location of existing drill holes available to be used as an IMW, two additional wells are proposed to extend coverage beyond existing locations. These wells (shown as stars on the above-mentioned figures) will be drilled and installed as IMWs prior to commencement of production. As new mining blocks come online, any IMWs encompassed within that mining block will be abandoned.

A yearly schedule of proposed IMWs for Stages 1 and 2 is provided in Table A-1, along with well name, location, and open (or screened) interval. Table A-1 shows the IMWs that will be monitored during any given year. By reading vertically down any column, it is possible to see which wells are inner IMWs, which are outer IMWs, and which will be abandoned. Wells denoted with an “I” are an inner IMW, those with an “O” are an outer IMW. When the well has an “A” designation, it will be abandoned in that year. The primary structure(s) intercepted by the proposed Stage 1 and Stage 2 IMWs are provided on Table A-2. The purpose of this table is to show the degree of connection along faults and bedding plane structures, both of which are significant to the overall conductivity in the ore deposit. By looking down a column for a given well, it can be determined if the well intersected the structure or has a secondary connection to the structure.

IMWs for Stage 3 will be identified according to a compliance schedule, with approval of EPA and ADEQ. As operational data are collected, alternate or additional IMWs may be proposed, but in any event adhering to the general principle of IMWs. Excelsior will notify EPA prior to implementing significant departures from this plan.

3.2.3 Injection Flow

Injection/recovery flows and hydraulic containment pumping will be actively managed to maintain an inward hydraulic gradient around the wellfield. The actual field conditions encountered during operation will determine the pumping and injection rates and the net pumping differential of the HC wells required to maintain an inward hydraulic gradient. Initially, Excelsior will pump the hydraulic control wells at a combined rate of 1% of the injection rate and monitor inward gradients at observation wells adjacent to the HC wells. The initial minimum hydraulic gradient will be set at 0.01 ft/ft. If excessive drawdown is observed at the HC wells such that the measured hydraulic gradient exceeds the minimum permitted hydraulic gradient, Excelsior will, with EPA concurrence, reduce the HC pumping so that the hydraulic gradient meets the permitted hydraulic gradient.

Data acquired from hydraulic control and observation well data will be evaluated to determine permit limits for inward hydraulic gradients. Excelsior will calculate a minimum gradient for each well pair based on their separation distance and from testing and observation during the first two months of pumping at the associated hydraulic control well. Barometric pressure and earth tide differences at the site (1 to 2 feet) are significant relative to potentially small head differences at observation wells; therefore, it will be important to remove barometric and earth tide responses from water level data collected with pressure transducers. Excelsior will use barometric data collected at the mine site in combination with two computer programs: Tsoft (2011, Royal Belgium Observatory) to generate synthetic earth tides and BETCO (2005, Sandia Corp.) to correct transducer water level pressures for barometric and earth tides. At this time, Excelsior believes a minimum gradient of 0.01 ft/ft will be sufficient and measureable, so two observation wells 100 feet apart should have a minimum head difference of 1 foot. Excelsior does not intend to use active pumping wells to calculate hydraulic gradients because well inefficiencies may exaggerate gradients. This methodology is conservative and defensible, while acknowledging the complex aquifer characteristics that have been identified and modeled.

During the first two months of operations, Excelsior proposes to operate the wellfield such that:

- hydraulic control pumping will be 1% of injection pumping.
- pumping volumes will be collected daily and re-balanced on a 48-hour basis so that the 1% net extraction is maintained.
- an inward hydraulic gradient will be maintained around the active portions of the in-situ wellfield, as measured in observation wells located near the hydraulic control wells (Figure A-7).

The first two months of operational data will be evaluated to determine appropriate permit limits regarding hydraulic gradients, net extraction rates, and the frequency of re-balancing on injection/recovery volumes.

Anticipated average and maximum injection volumes are provided in Attachment H.

3.2.4 Injection Pressure

Excelsior proposes a conservative maximum injection pressure gradient of 0.75 psi/foot to prevent hydraulic fracturing and propagation of existing fractures, based on fracture gradient testing conducted in 2015. Details of the testing methodology and analyses are provided in Attachment I-2.

3.2.5 Borehole Abandonment

ADEQ's Mining BADCT Guidance Manual (2004) and 40 CFR §144.55 identify plugging and abandonment of potential conduit wells and boreholes as a "corrective action" under UIC and as an appropriate BADCT element for ISR with deep well injection projects. Information regarding corrective actions is provided in Attachment C. Plugging and abandonment of the boreholes will be conducted using a method consistent with the “Standard Abandonment Method” in the ADWR Well Abandonment Handbook (2008) and included in Attachment Q-2.

3.2.6 Well Construction

Wells installed at the Gunnison Copper Project will include injection, recovery, hydraulic control, observation wells and point of compliance (POC) wells. These wells will be constructed to meet Class III requirements. Several possible well designs, including varying diameters, are planned for the injection, recovery, and hydraulic control wells. The injection, recovery, and hydraulic control wells are proposed to have open-hole completions within the ore body, which ranges from approximately 400 to 800 feet in thickness. Observation wells and POC wells will be constructed with well screen. Additional details are provided in Attachments L and M.

3.2.7 Mechanical Integrity Testing

Part 1 Mechanical Integrity Testing will be conducted on all new injection and recovery wells, hydraulic control, observation, POC wells.

After construction of an injection/recovery, hydraulic control, observation well, or POC well is complete, Part 1 of the UIC mechanical integrity testing requirement will be addressed by the following method or another suitable method approved by ADEQ and EPA: A packer will be installed immediately above the bottom of the cased interval, and the casing will be completely filled with water. A hydraulic pressure equal to or above the maximum allowable wellhead injection pressure will be applied. The test will be conducted for a minimum of 30 minutes. The well will be considered to have passed if there is less than a five (5) percent loss of pressure during the 30-minute period. Part 1 mechanical integrity will be demonstrated before a Class III well is put into service and when there is reason to suspect a well failure.

If a packer completion is used (as shown in Attachment M), mechanical integrity testing of the tubing-casing annulus pressure will be conducted according to UIC requirements.

Part 2 MI testing will be conducted on all wells (hydraulic control, observation well, POC, injection/recovery) except IMW wells as part of the planned geophysical logging. As noted in Attachment L, Section 3.2, after injection/recovery well construction is complete, the well will be logged using the following borehole geophysical methods:

- Gamma
- Sonic (injection wells only)
- Temperature (all wells)

- Caliper
- ABI (Acoustic Borehole Image)
- Cement bond logs (only on wells with steel casing) for Part 2 Mechanical Integrity.
- Directional survey

The temperature logs will meet the Part 2 mechanical integrity requirement for wells constructed with PVC and/or FRP materials. The cement bond log will meet the Part 2 mechanical integrity requirement for wells with steel casing.

Existing core holes or other existing borings/wells used for intermediate monitoring will not be tested. The IMWs will be plugged and abandoned prior to injecting in the block in which they are located.

Additional information regarding Mechanical Integrity testing is provided in Attachment P.

3.2.8 Wellfield Closure Strategy

Closure of the wellfield will include rinsing to remove residual PLS and well abandonment, as discussed in the sections below. The closure strategy consists of the following elements:

- Rinsing
- Well plugging and abandonment
- Report preparation
- Post-closure monitoring

3.2.8.1 Rinsing

A rinsing closure strategy is proposed for the wellfield. After copper recoveries drop below the economic cutoff, ISR in a given production block will be deemed complete and the block will be rinsed using fresh groundwater until applicable water quality standards are met. A flow chart that summarizes the closure strategy is provided as Figure A-18.

Based on geochemical modeling by Duke HydroChem (Attachment H-2), the following 3-step rinsing strategy is proposed:

- Rinse three (3) pore volumes (based on a 3% fracture porosity of the ore body)
- Rest
- Rinse two (2) pore volumes

Step 1 will result in a mix of 5% PLS and 95% groundwater after rinsing with three pore volumes, based on core tray and column testing documented in a rinsing report by Clear Creek (Attachment H-3). The mechanism by which solute is removed during Step 1 is advective flow, i.e. flushing of the fractures.

Step 2 allows the solution to be neutralized as silicate and carbonate minerals are altered. Solute concentrations will be controlled by precipitation of secondary minerals and complexation (sorption) on hydrous ferric oxide surfaces. The resting period will continue until pH of the resident solution is circumneutral and all regulated constituents are at or below AWQSs and MCLs. The geochemical model results indicate that these conditions would be attained after a resting period of approximately one year (Attachment H-2).

Step 3 is a final rinse of two pore volumes. This step will facilitate removal of any constituents that might still be present at or near regulatory limits. Similar to Step 1, the solute removal mechanism of Step 3 is flushing.

To get to final closure, the following steps (which are also shown on the flow chart—Figure A-18) will be taken:

- Monitoring of groundwater from the mining block after rinsing will be conducted to evaluate the effectiveness of the rinsing. For mining block 1, all extraction wells will be sampled to characterize post-rinsing groundwater quality after step 3. If the data from mine block 1 indicate that sampling 10%[2] of recovery wells will adequately characterize post-rinsing groundwater conditions, in subsequent blocks rinse verification samples will be collected from approximately 10% of the recovery wells within the mining block after step 3. This represents approximately one well for every 1.5 acres of the wellfield (Figure A-19). These wells (approximately one well per 1.5 acres) will be designated the "Rinse Verification Wells" (RVWs). The RVWs will remain open and available throughout the mine life to assist with closure verification and post rinse remediation if required. Analyses will be conducted for UIC permit and APP-regulated metals (dissolved), sulfate, TDS, pH, VOCs[3] and specific conductance. Excelsior will select these wells based on their spatial, geological, hydrogeological, and geochemical representativeness. Only recovery wells will be sampled, as rinsed injection wells will not be representative of the bedrock groundwater chemistry. If analyses

[2] In Mine Block 1, 100% of recovery wells will be sampled. Following EPA's approval of a demonstration that sampling 10% of recovery wells is statistically equivalent to 100%, the sampling frequency will be 10% thereafter.

[3] Excelsior proposes to use the full EPA 8260B analyte list for VOC analyses, as listed in the EPA Method.

indicate that AWQSs or MCLs are not achieved in the block, rinsing and/or resting will resume.

- When AWQSs and MCLs are achieved in the RVWs, the remaining (non-RVW) wells in the mining block will be plugged and abandoned, leaving only the RVWs which represent approximately one well per 1.5 acres.
- An appropriate number (a subset) of RVWs will be selected as post-rinse IMWs. These wells will be selected to intersect major flow pathways while providing good geographic coverage. Their purpose is to identify possible migration of mining fluids from adjacent active mining areas back into previously-rinsed mining blocks. These IMWs will be continuously monitored for water elevation and specific conductance. A post-rinse ambient specific conductance level for the RVWs will be set as an AL that is indicative of compliance with AWQSs and MCLs, based on empirical data ("post-rinse AL") gathered during previous monitoring.
- In the event of increasing specific conductance above the ALs in the IMWs, Excelsior will implement one or more of the following response(s):
  - Continued monitoring to establish neutralization capacity and/or
  - Adjust operations to reverse the trend (pull back solutions) and/or
  - Adjust nearby rinsing operations to reverse the trend

- When an area is to be closed because it is the end of the mine life or there is no future mining planned adjacent or up-gradient, a subset of the RVWs will be identified (approximately 1 well every 13.5 acres as shown on Figure A-19). These wells will be designated as "Closure Verification Wells" or CVWs. CVWs will remain open through the life of the project, until their abandonment after post-closure monitoring is complete. Samples from these wells will be analyzed by laboratory methods for APP-regulated metals (dissolved), sulfate, TDS, pH, VOCs and specific conductance. When all CVWs in an area meet AWQS or MCLs then applicable hydraulic control wells will be turned off (but not abandoned), and post-closure monitoring will begin.
  - Post-closure monitoring will be conducted to determine if rebound above AWQS or MCLs has occurred. Monitoring of CVWs and outer observation wells will continue once per year until five consecutive years of CVWs and outer observation wells meeting AWQSs and MCLs has occurred. If in any year AWQSs or MCLs are not met in a particular area, appropriate HC wells can be turned back on and additional pumping, rinsing or resting of CVWs and/or adjacent RVWs can occur.
  - When all CVWs and outer observation wells have met AWQSs and MCLs for five consecutive years, monitoring will stop and all wells (RVWs, CVWs, HC, Observation and POC) will be plugged and abandoned.

Hydraulic control will be maintained and monitoring of POC wells will continue, as required under the APP, until closure goals are achieved. Prior to well plugging and abandonment of a mining block, a report will be submitted to ADEQ and EPA documenting the rinsing and monitoring data. The report will include documentation of the volumes of rinse water injected and recovered, results of laboratory analytical analyses after Step 3, and a recommendation will be provided on whether additional rinsing is needed. Well plugging and abandonment will not commence without approval from ADEQ and EPA. As discussed above, approximately one well every 1.5 acres will be designated as Rise Verification Wells (RVWs), a subset of which will become either post-rinse IMWs or later Closure Verification Wells (CVWs) and will not be abandoned until the end of the life of mine, to allow for monitoring as described above.

Well rinsing costs for Stage 1 operations are provided in revised Attachment R-3.

3.2.8.2 Well Plugging and Abandonment

Well plugging and Abandonment procedures will be conducted according to the methodology in Attachment Q-1.

After the goals of the rinsing are met, the wells in the wellfield, which are classified as Class III injection wells under the UIC regulations, will be plugged and abandoned, as required under 40 CFR 146.10 and the UIC permit. This requires that wells be abandoned in such a way that fluid will not move into USDWs. In addition to the federal requirements, AAC R12-15-816 contains abandonment requirements and additional guidance is provided in the ADWR Well Abandonment Handbook (ADWR, 2008). The handbook states that the abandonment of a well be accomplished “through filling or sealing the well so as to prevent the well, including the annular outside casing, from being a channel allowing the vertical movement of water.” Class III Well plugging and Abandonment procedures will be conducted according to Attachment Q-1.

Following the plugging and abandonment of Class III injection/recovery wells, reports will be filed with state and federal agencies as described below.

- <u>ADWR:</u> Within 30 days of the completion of plugging and abandonment, the drilling contractor will submit a Well Abandonment Completion Report (Form 55-58) to ADWR. Within 30 days of completion of plugging and abandonment, Excelsior or their designee will submit a Well Owner’s Notification of Abandonment (Form 55-36). The forms are included as Exhibit B.
- <u>USEPA:</u> Excelsior will report plugging and abandonment activities in the quarterly monitoring reports sent to the USEPA Director. The plugging and abandonment will be included in the quarterly report for the quarter in which the

activities were completed. Reporting data will include an updated version of Form 7520-14 and copies of the forms sent to ADWR described above.

- ADEQ: Will receive copies of all documentation of plugging and abandonment activities that are sent to ADWR and USEPA.

3.2.8.3 Post-Closure Groundwater Monitoring

Geochemical modeling (Attachment H.2) has shown that AWQSs will be achieved after rinsing. Post closure monitoring will be conducted. Because Excelsior intends to rinse until MCLs and AWQSs are achieved within the wellfield, monitoring at the POCs will not be conducted. Rather, post-closure monitoring will be conducted to determine if rebound above AWQS or MCLs has occurred. Monitoring of CVWs and outer observation wells will continue once per year until five consecutive years of CVWs and outer observation wells meeting AWQSs and MCLs has occurred. If in any year AWQSs or MCLs are not met in a particular area, appropriate HC wells can be turned back on and additional pumping, rinsing or resting of CVWs and/or adjacent RVWs can occur. post-closure monitoring will be conducted at the selected CVWs within the wellfield and outer observation wells for 5 years. The samples will be collected annually, according to the methodology prescribed in the permit.

When all CVWs and outer observation wells have met AWQSs and MCLs for five consecutive years, monitoring will stop and all wells (RVWs, CVWs, HC, Observation and POC) will be plugged and abandoned.

4. AREA OF REVIEW

4.1 Approach

According to Title 40 §146.6:

The area of review for each injection well or each field, project or area of the State shall be determined according to either paragraph (a) or (b) of this section. The Director may solicit input from the owners or operators of injection wells within the State as to which method is most appropriate for each geographic area or field.

(a) Zone of endangering influence.

(1) The zone of endangering influence shall be:

(i) In the case of application(s) for well permit(s) under §122.38 that area the radius of which is the lateral distance in which the pressures in the injection zone may cause the migration of the injection and/or formation fluid into an underground source of drinking water; or

(ii) In the case of an application for an area permit under §122.39, the project area plus a circumscribing area the width of which is the lateral distance from the perimeter of the project area, in which the pressures in the injection zone may cause the migration of the injection and/or formation fluid into an underground source of drinking water.

(2) Computation of the zone of endangering influence may be based upon the parameters listed below and should be calculated for an injection time period equal to the expected life of the injection well or pattern. The following modified Theis equation illustrates one form which the mathematical model may take.

$$r = \left[\frac{2.25\, KHt}{S10^x} \right]^{1/2}$$

where:

$$X = \frac{4\pi KH \left(h_w - h_{bo} \times S_p G_b \right)}{2.3Q}$$

- *r=Radius of endangering influence from injection well (length)*
- *k=Hydraulic conductivity of the injection zone (length/time)*
- *H=Thickness of the injection zone (length)*
- *t=Time of injection (time)*
- *S=Storage coefficient (dimensionless)*
- *Q=Injection rate (volume/time)*
- *hbo=Observed original hydrostatic head of injection zone (length) measured from the base of the lowermost underground source of drinking water*
- *hw=Hydrostatic head of underground source of drinking water (length) measured from the base of the lowest underground source of drinking water*
- *Sp Gb=Specific gravity of fluid in the injection zone (dimensionless)*
- *π=3.142 (dimensionless)*

The above equation is based on the following assumptions:

(i) The injection zone is homogenous and isotropic;

(ii) The injection zone has infinite area extent;

(iii) The injection well penetrates the entire thickness of the injection zone;

(iv) The well diameter is infinitesimal compared to "r" when injection time is longer than a few minutes; and

(v) The emplacement of fluid into the injection zone creates instantaneous increase in pressure.

(b) Fixed radius.

(1) In the case of application(s) for well permit(s) under §122.38 a fixed radius around the well of not less than one-fourth (1/4) mile may be used.

(2) In the case of an application for an area permit under §122.39 a fixed width of not less than one-fourth (1/4) mile for the circumscribing area may be used.

In determining the fixed radius, the following factors shall be taken into consideration: Chemistry of injected and formation fluids; hydrogeology; population and ground-water use and dependence; and historical practices in the area.

(c) If the area of review is determined by a mathematical model pursuant to paragraph (a) of this section, the permissible radius is the result of such calculation even if it is less than one-fourth (1/4) mile.

Excelsior's AOR method is based on the mathematical approach (a) described above. The AOR is determined by a mathematical model, and thus, section (c) above applies. An AOR radius of less than ¼ mile is permissible using this method.

4.2 Numerical Model

Documentation of the mathematical model used to delineate the AOR is provided as Exhibit A-2. Excelsior also used this model in support of an Aquifer Protection Permit (APP) application that was submitted to the Arizona Department of Environmental Quality (ADEQ).

The numerical groundwater flow model was constructed by Clear Creek using a number of extensive datasets, including detailed mapping of fracture intensity, which is key to groundwater flow in the Project area. MODFLOW-NWT (*A Newton Formulation of MODFLOW 2005*, Niswonger, 2011), was the numerical code selected to simulate groundwater flow in the Project area. MODFLOW-NWT an updated version of the 3D finite-difference code based on the widely used United States Geological Survey (USGS) model program MODFLOW (McDonald and Harbaugh, 1988).

The governing equation for MOFLOW is the partial-differential equation of groundwater flow (McDonald and Harbaugh, 1988):

$$\frac{\partial}{\partial x}\left(Kxx\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(Kyy\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(Kzz\frac{\partial h}{\partial z}\right)+W=Ss\frac{\partial h}{\partial t}$$

Where:

- Kxx, Kyy, and Kzz are values of hydraulic conductivity along the x, y, and z axes (feet/day),
- H is the potentiometric head (feet)
- W is the volumetric flux per unit or recharge rate ($time^{-1}$)
- Ss is the specific storage of the aquifer material ($foot^{-1}$)
- t is time (days).

The MODFLOW NWT code (Newton Raphson formulation), includes an upstream weighting package (UPW), which simulates a continuous hydraulic conductivity field from saturated to unsaturated model cells allowing for smoother representation of wet and dry model cells. This is done by implementing a continuous pseudo-soil function representation for head from dry to wet cell conditions, as opposed to the discrete dry/wet approach used in previous versions of MODFLOW. This approach allows for a smoother representation of saturation conditions, more accurately reflecting the aquifer rewetting and drying conditions.

The model's finite difference grid consists of 209 rows, 209 columns, and 7 layers for a total of 305,767 calculation cells. Of those, 173,523 cells are active. Cells range from 300 feet square to 75 feet square in the area of the ore reserve. The model domain covers an area of 87.8 square miles and encompasses the major hydrologic drainages in the vicinity of the Project. Additional details regarding the data inputs, boundary conditions, recharge, hydraulic properties, model calibration, hydraulic containment, and particle tracking are provided in the Groundwater Model Report (Attachment A-2).

4.3 AOR Delineation

Due to geologic and hydrogeologic heterogeneities, the model does not support a fixed radius around the wellfield. Instead, the proposed distance of the AOR from the wellfield boundary varies and is based on the existing hydraulic gradients and model outputs showing areas of influence of the hydraulic control wells on the east side of the wellfield.

The rationale for the spacing and number of HC wells is provided in Section 5.1.2 of Attachment A-2. HC wells were initially sited approximately 300 feet apart. Their locations were adjusted to maintain capture and wells were added to zones of high hydraulic conductivity. The resulting 30 HC well locations are the result of numerous simulations and adjustments necessary to attain particle capture. Every HC well will be tested to measure hydraulic parameters including transmissivity, hydraulic conductivity, and storage coefficient. Because the HC wells are numerous and closely spaced, observation well pairs located at every third HC well are sufficient to demonstrate inward gradients for the HC system.

The proposed AOR encompasses 332 acres. The proposed AOR boundary is shown on Figure A-7. The AOR boundaries are described as follows:

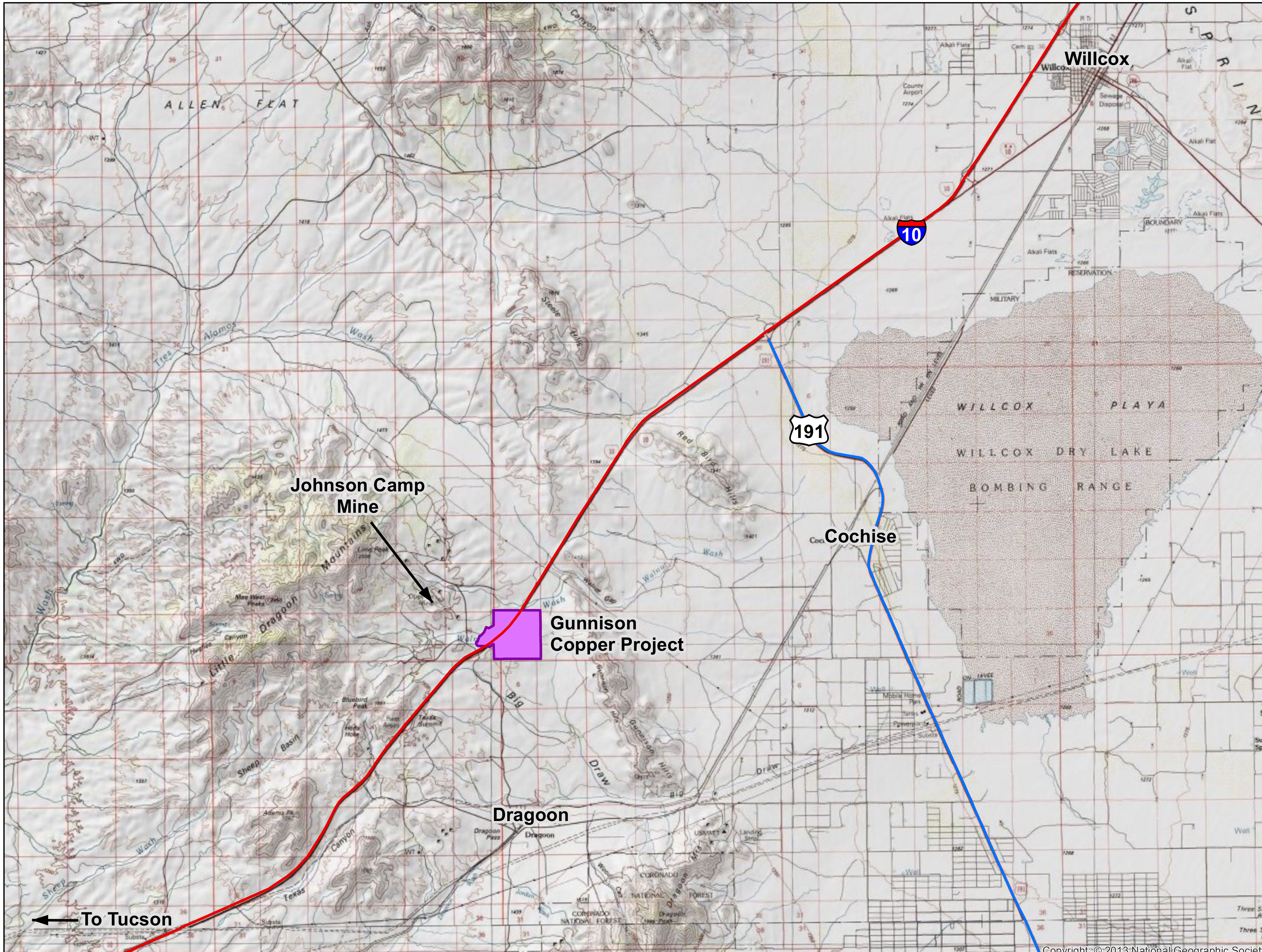
Western Boundary of AOR - Groundwater flows from the west into the wellfield along the western boundary. The proposed AOR boundary is coincident with the property boundary, which is approximately 100 feet from the nearest injection wells. Due to the high eastward hydraulic gradient, injection flows cannot overcome the eastward flow direction. Particle tracking in the groundwater model shows that HC wells are not needed along the western boundary, and in fact, they would counteract the natural gradient that prevents excursions to the west[4]. Excelsior intends to use intermediate monitoring wells to the west to demonstrate inward gradients.

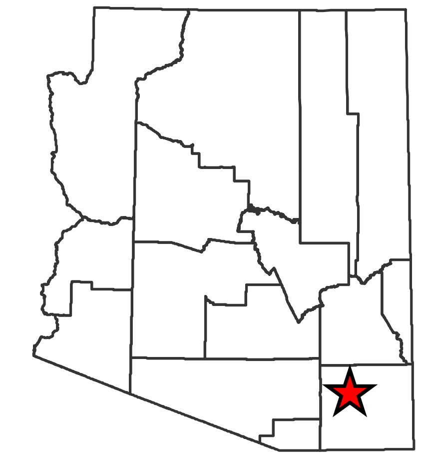
Eastern Boundary – (from the southeast corner of the AOR to the northern extent): The AOR extends approximately 1,200 feet to the east of the outermost wells in the ISR wellfield. The eastern side of the AOR is based on the maximum capture zones for hydraulic control wells on the east side of the wellfield (Figure 73 in Attachment A-2). The hydraulic control wells serve as a barrier to contain pollutants, and the hydraulic control wells' areas of influence, which are critical to pollutant containment, are also considered to be within the AOR along the eastern boundary. The areas of influence of the hydraulic control wells were identified on vector plots produced by the numerical model (Figures 67, 68, and 69 in Attachment A-2).

Southern Boundary of AOR: The AOR on the south side of the wellfield coincides with the property boundary. Containment along the south edge of the wellfield is primarily provided by the regional hydraulic gradient, which is parallel to the property boundary. Hydraulic containment wells along this boundary provide additional containment, as shown by velocity vectors (Figures 67, 68, and 69 in Attachment A-2). Due to the natural groundwater flow direction in this area, the AOR does not need to extend out to the full area of influence of the hydraulic control wells. On the west (upgradient) side of the wellfield, eastward flow gradients provide adequate containment, so, with the exception of HC-29 and HC-30 there are no hydraulic containment wells on the west side of the wellfield. Hydraulic containment wells HC-29 and HC-30 were sited due to small excursions from the wellfield identified in the model (Attachment A-2). The AOR coincides with the western property boundary to the west.

Figure A-7A is provided to show the locations of injection, recovery, POC, HC, and observation wells. Locations of injection/recovery wells should be considered approximate at this time; their locations may shift slightly based on observations of site-specific conditions at the time of well installation. This is justifiable because Excelsior is applying for an area UIC permit. Under §144.33 (a)(1), the "Director may issue a permit on an area basis, rather than for each well individually, provided that the permit is for injection wells (1) described and identified by location in permit application(s) *if they are existing wells*, except that the Director may accept a single description of wells with substantially the same characteristics.."

[4] In addition, HC wells to the west would not be conservative of the groundwater resource.





Legend

Gunnison Copper Project

0 1 2 4
Miles

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Gunnison Copper Project
UIC Permit Application
February 2016

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1/19/16	373-008D

N

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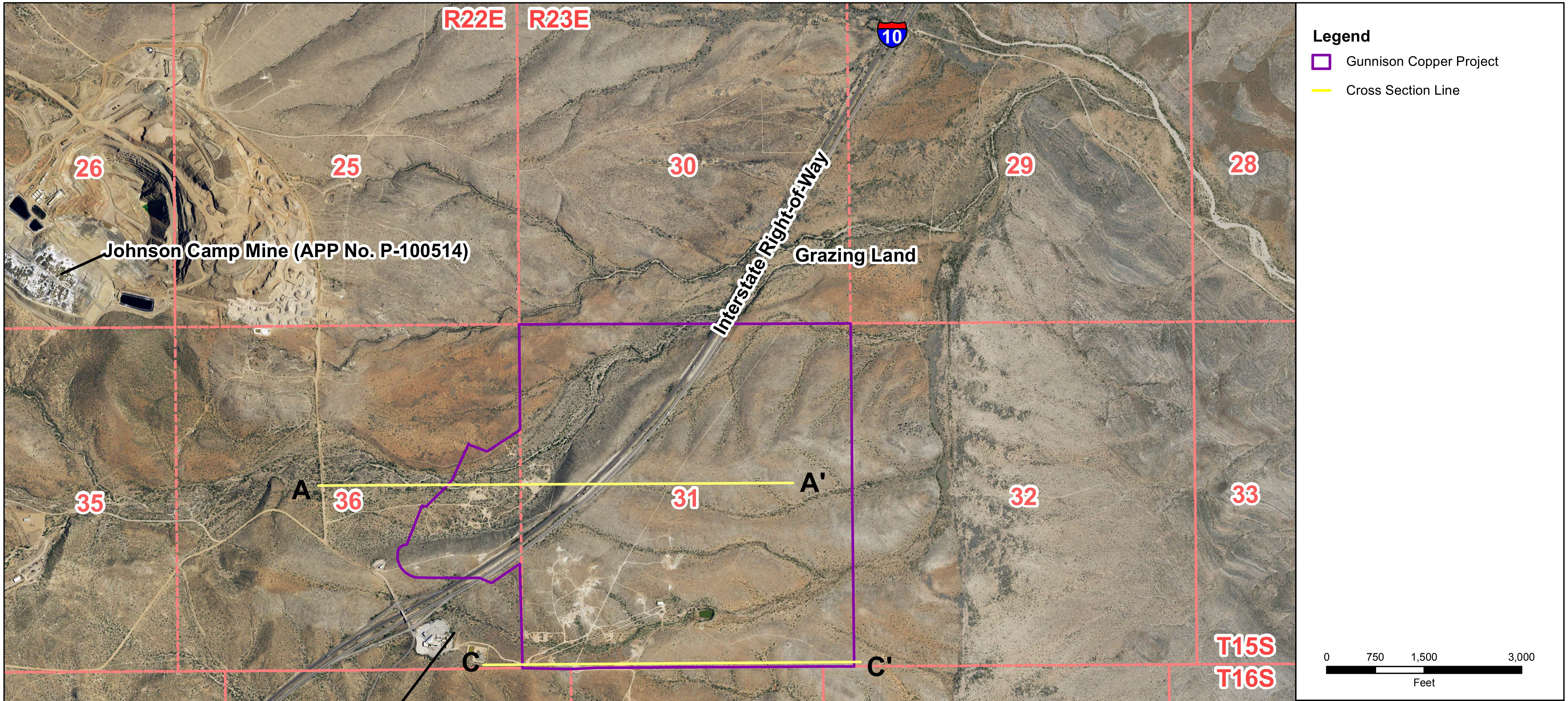
FIGURE A-1
Project Location



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1/19/16	373-014A

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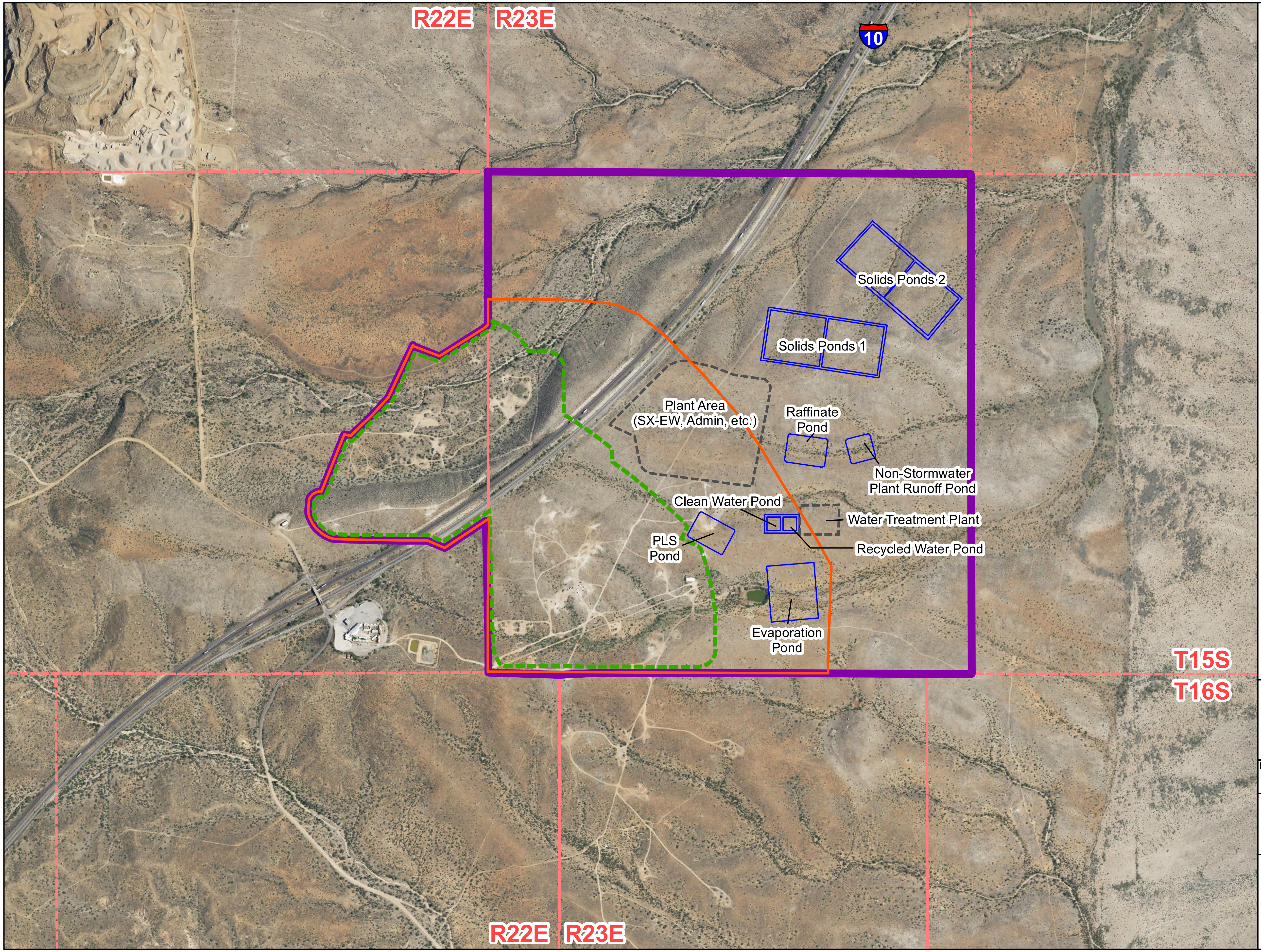
FIGURE A-2
Current Land Use



Legend

- Gunnison Copper Project
- Wellfield
- Other Mine Structures
- Area of Review
- Pond

0 500 1,000 2,000
Feet

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Gunnison Copper Project
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1/21/18	373-013B

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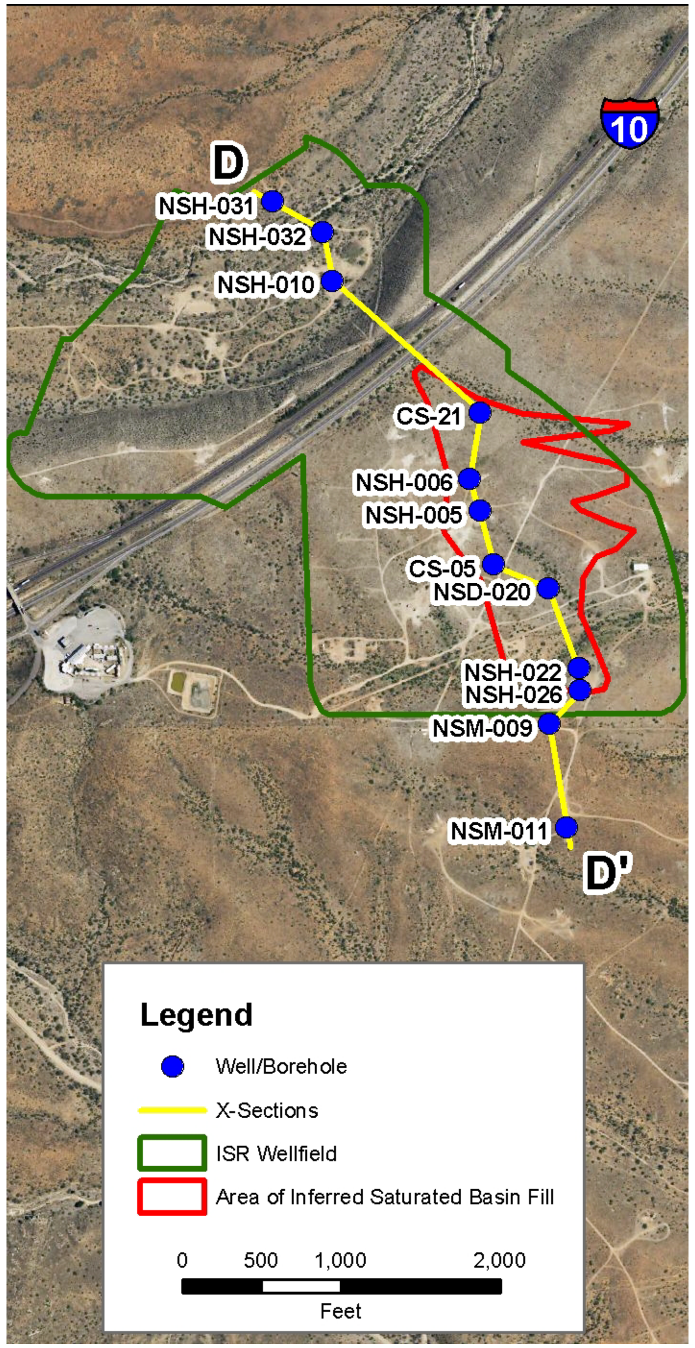
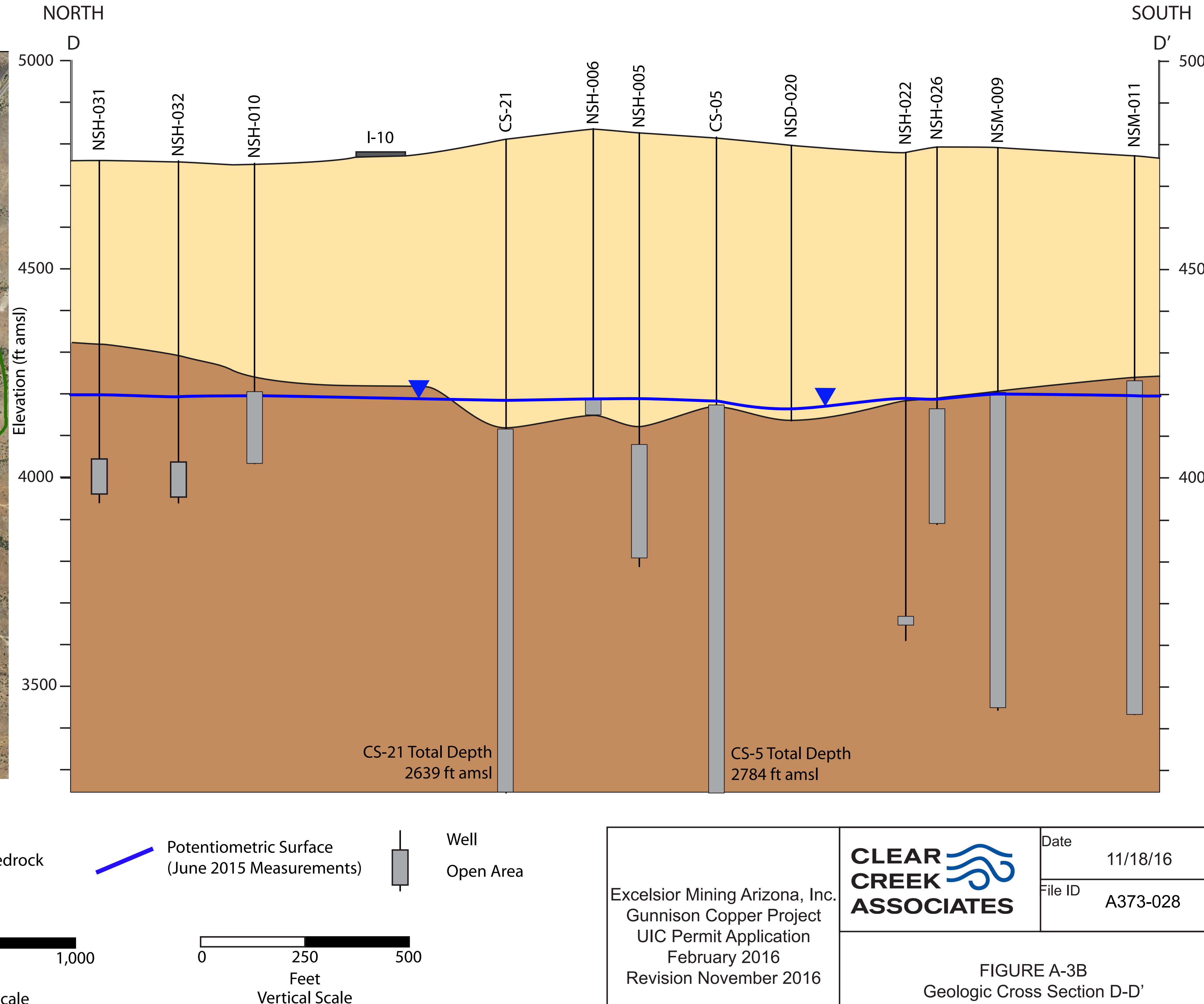
FIGURE A-3
Facility Site
Plan





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Revision November 2016

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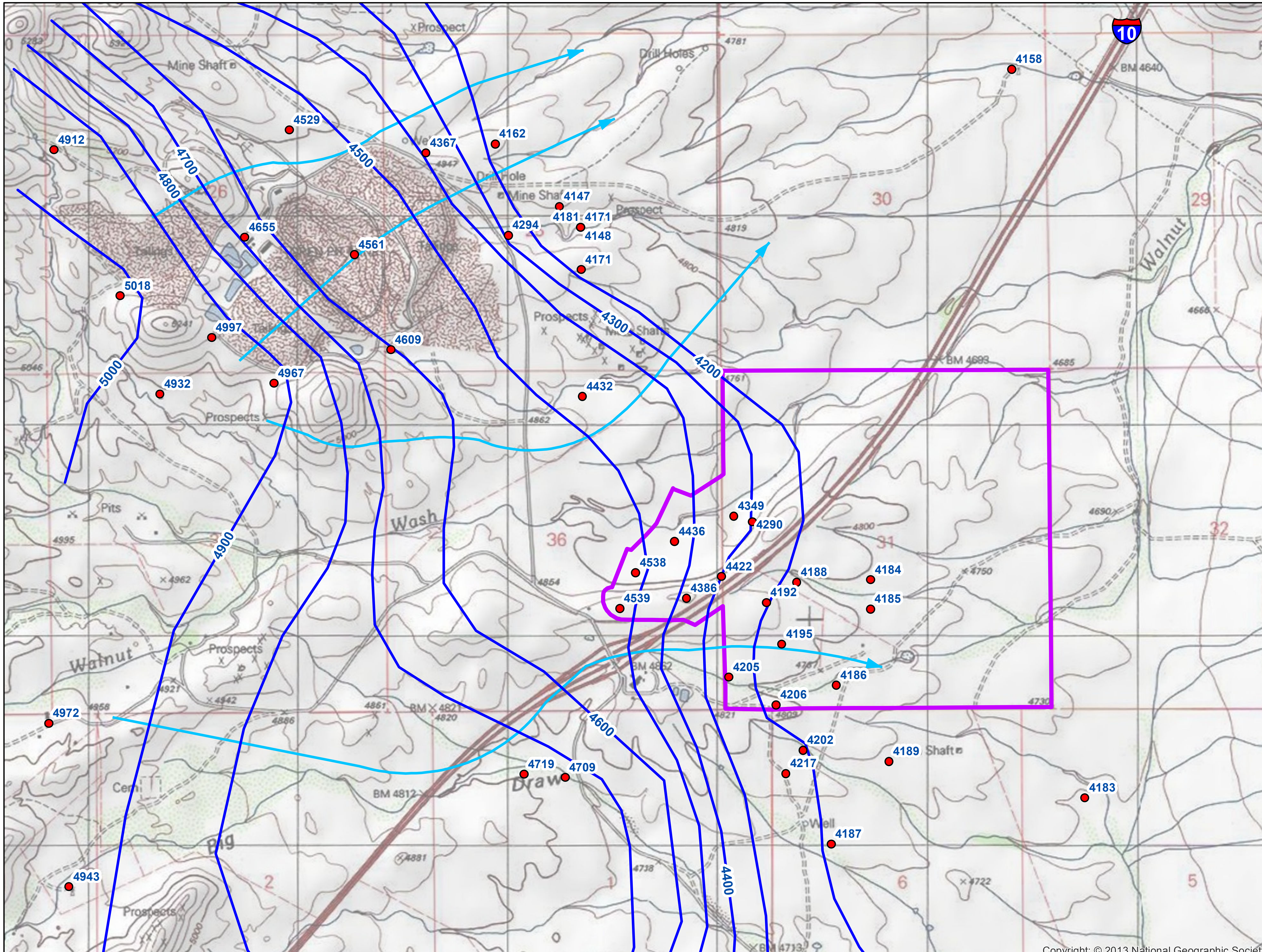
Date 11/18/16

File ID A373-028

FIGURE A-3B
Geologic Cross Section D-D'



Legend

- Well - Groundwater Elevation (ft amsl)
- Groundwater Elevation (ft amsl) 100 ft contour interval
- Groundwater Flow Direction
- Gunnison Copper Project

Site water levels are from June 2015
All other water levels are the most recent data from 1949 to the present

0 750 1,500 3,000
Feet

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1/21/16	373-031A

N

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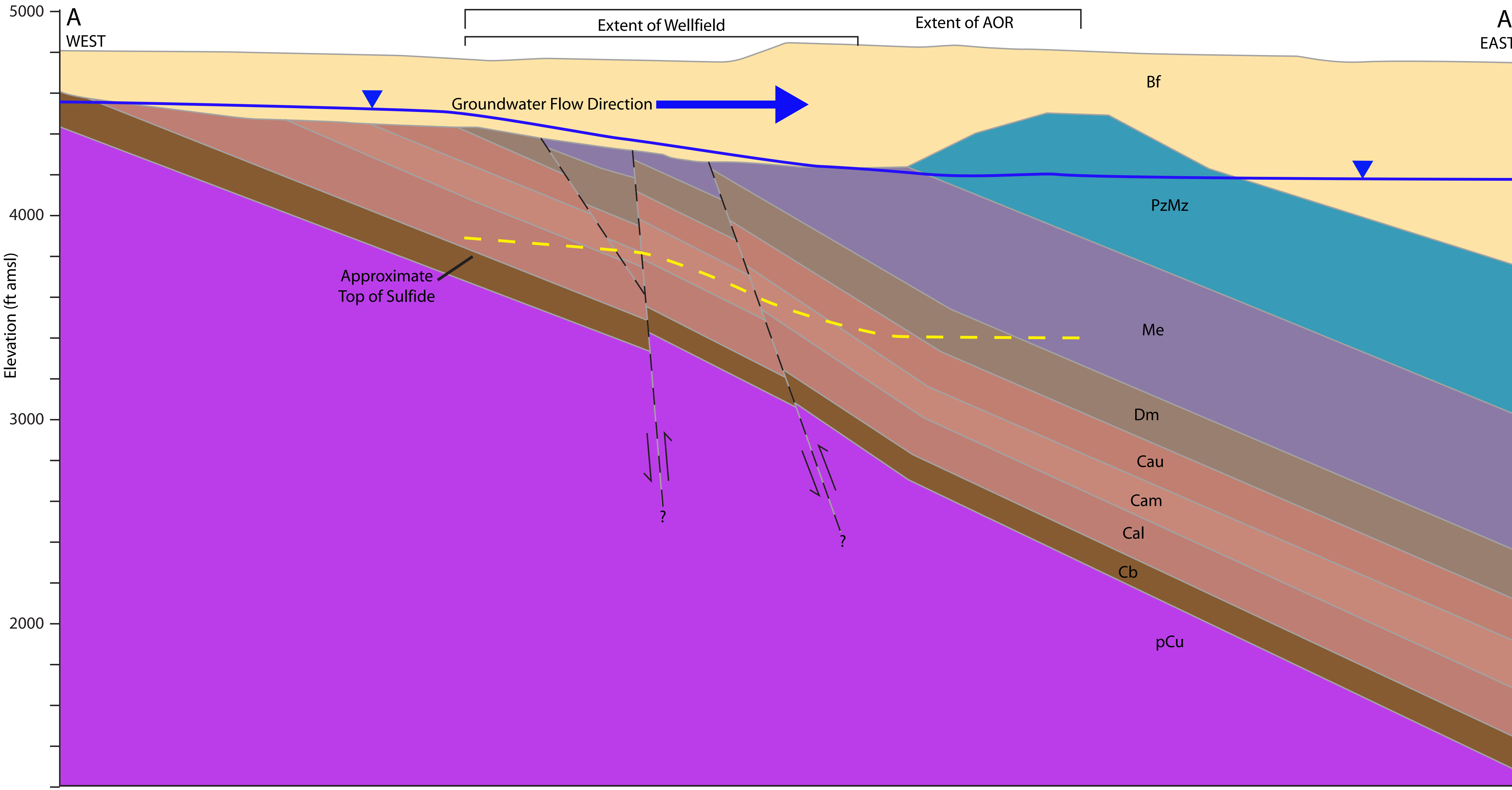
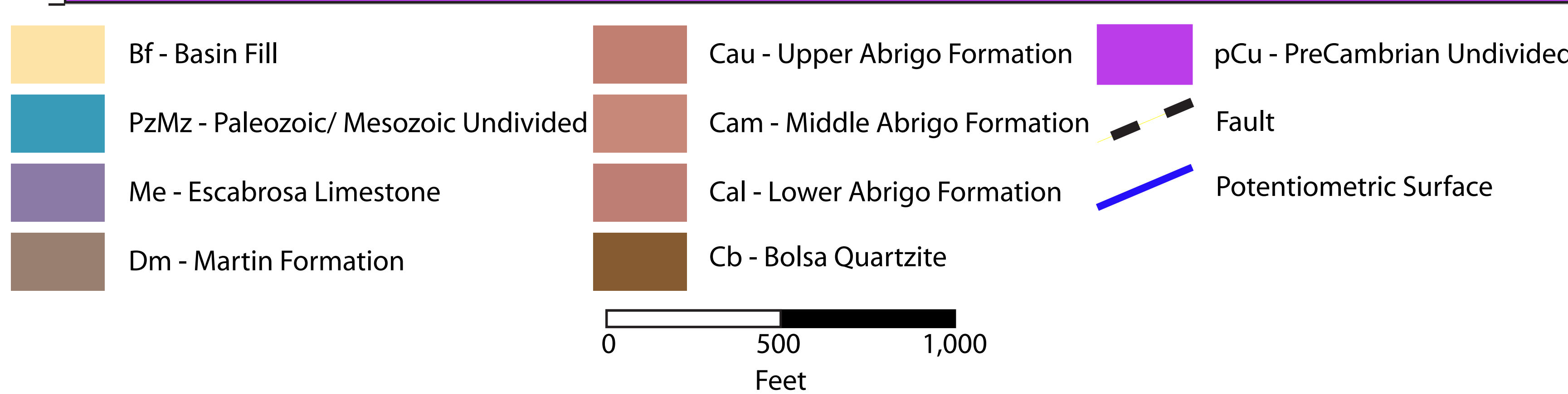
FIGURE A-4
Potentiometric Surface Map



Source: Excelsior Geologic Model



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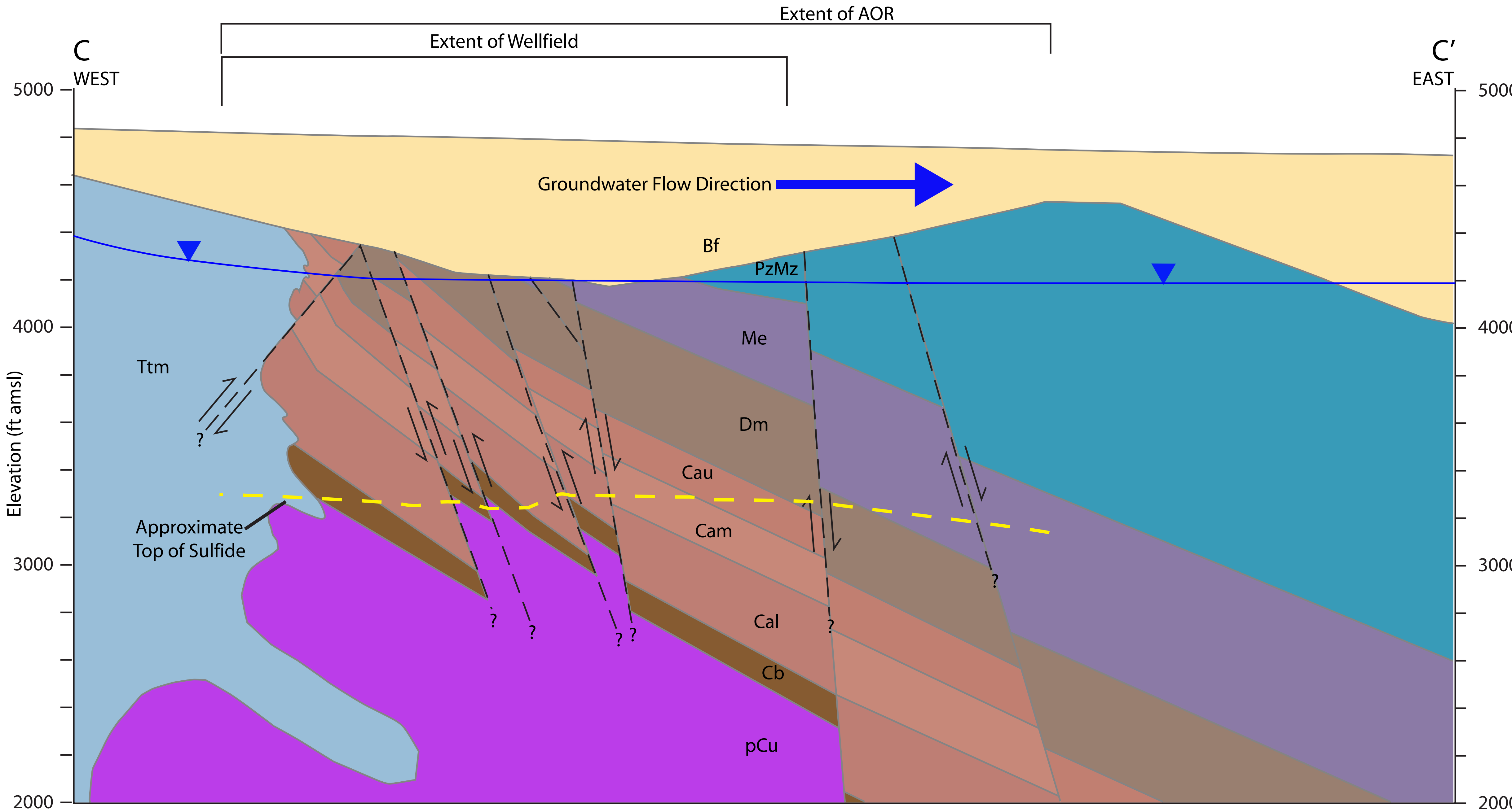
		File ID A373-010A	
	FIGURE A-5 Geologic Cross Section A - A'		



Source: Excelsior Geologic Model

- Bf - Basin Fill
- Ttm - Texas Canyon Quartz Monzonite
- PzMz - Paleozoic/ Mesozoic Undivided
- Me - Escabrosa Limestone
- Dm - Martin Formation
- Cau - Upper Abrigo Formation
- Cam - Middle Abrigo Formation
- Cal - Lower Abrigo Formation
- Cb - Bolsa Quartzite
- pCu - PreCambrian Undivided
- Fault
- Potentiometric Surface

0 500 1,000
Feet

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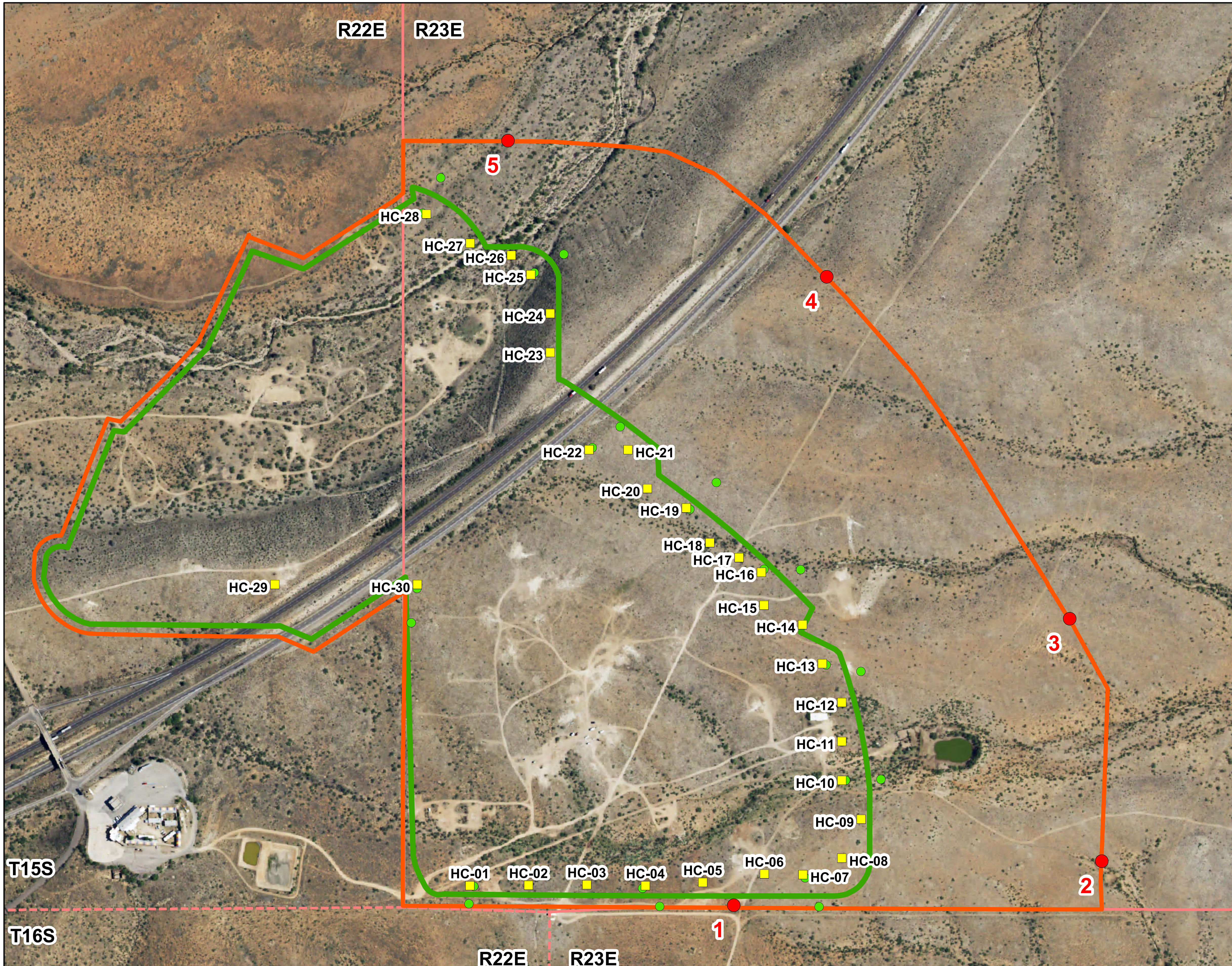
	FIGURE A-6 Geologic Cross Section C - C'	



Legend

- Point of Compliance Well
- Hydraulic Control Well
- Observation Well
- Area of Review
- ISR Wellfield

Observation Wells will have same number as associated hydraulic control well.

Example: At HC-1, observation wells will be named:

OW-1-I (inner)
OW-1-O (outer)

0 250 500 1,000
Feet

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Gunnison Copper Project
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1/19/16	373-035B

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FIGURE A-7
Area of Review, Point of Compliance, Hydraulic Control, and Observation Well Locations

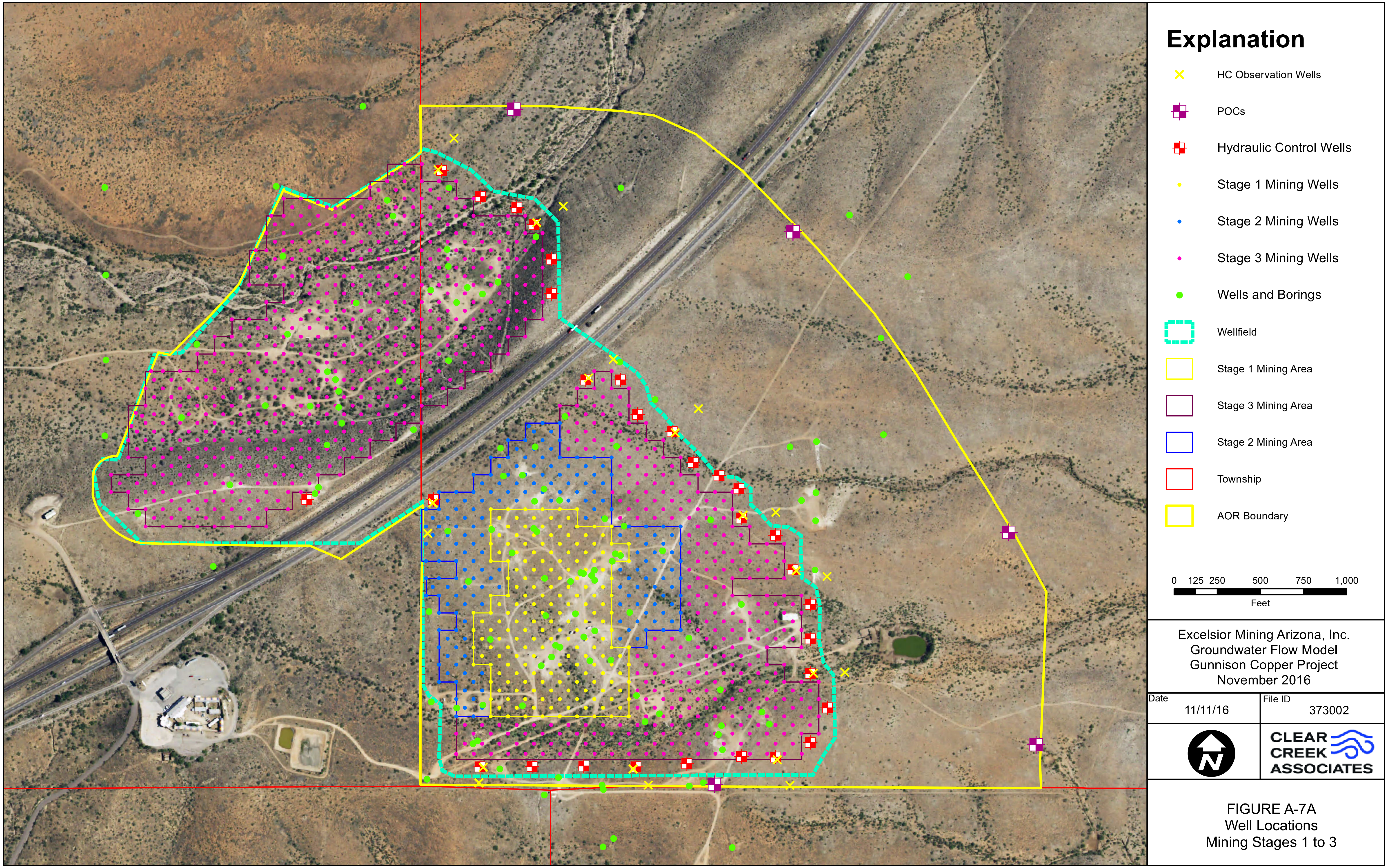
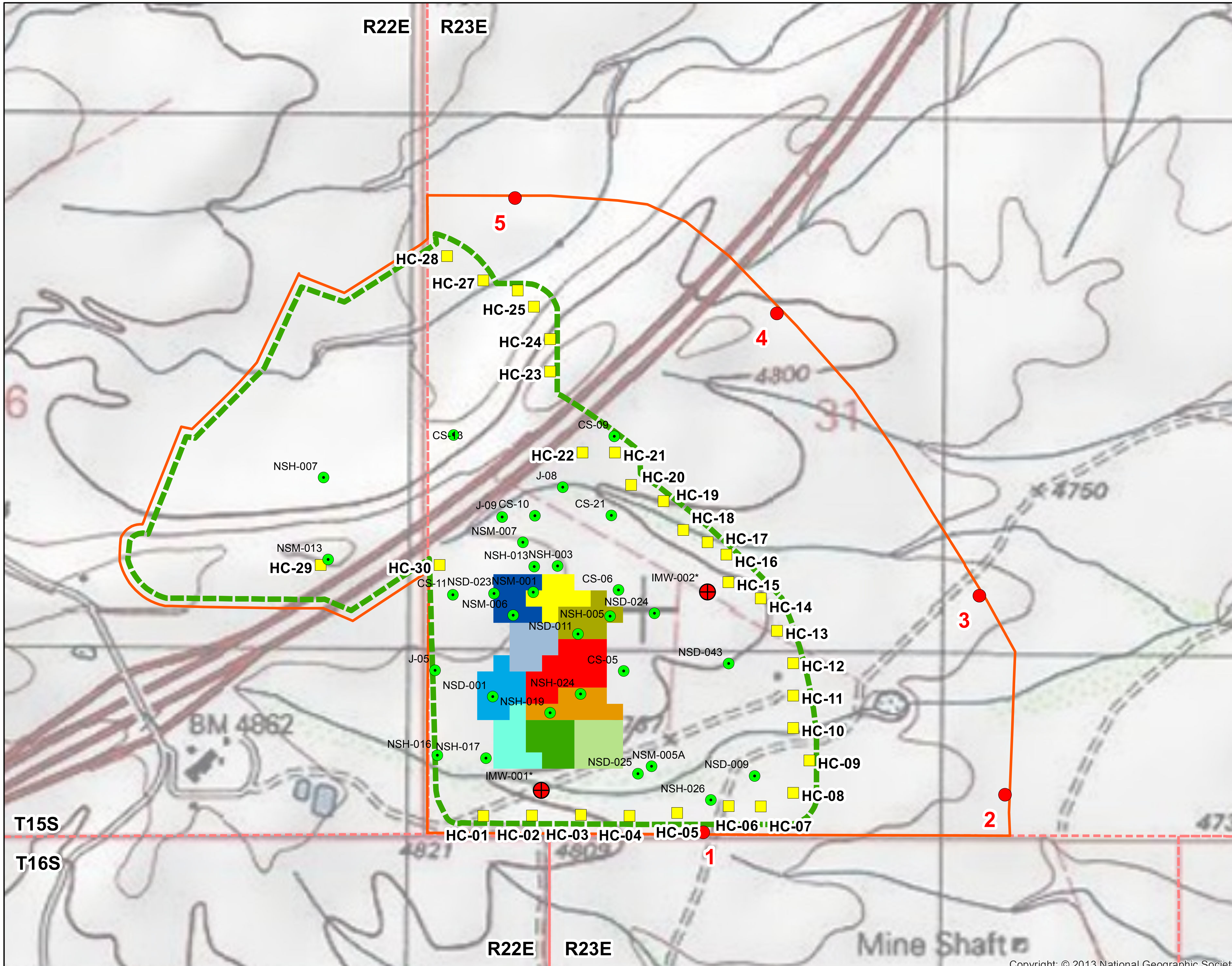


FIGURE A-7A
Well Locations
Mining Stages 1 to 3



Legend

- Area of Review
- ISR Wellfield
- POC-Wellfield
- Hydraulic Control Well
- Existing IMWs
- IMWs to be installed

Mine Blocks

- Year 1
- Year 2
- Year 3
- Year 4
- Year 5
- Year 6
- Year 7
- Year 8
- Year 9
- Year 10

Observation Wells will have same number as associated hydraulic control well.

Example: At HC-1, observation wells will be named:

OW-1-I (inner)
OW-1-O (outer)

0 250 500 1,000
Feet

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Revised March 2017

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3/28/17	373-068

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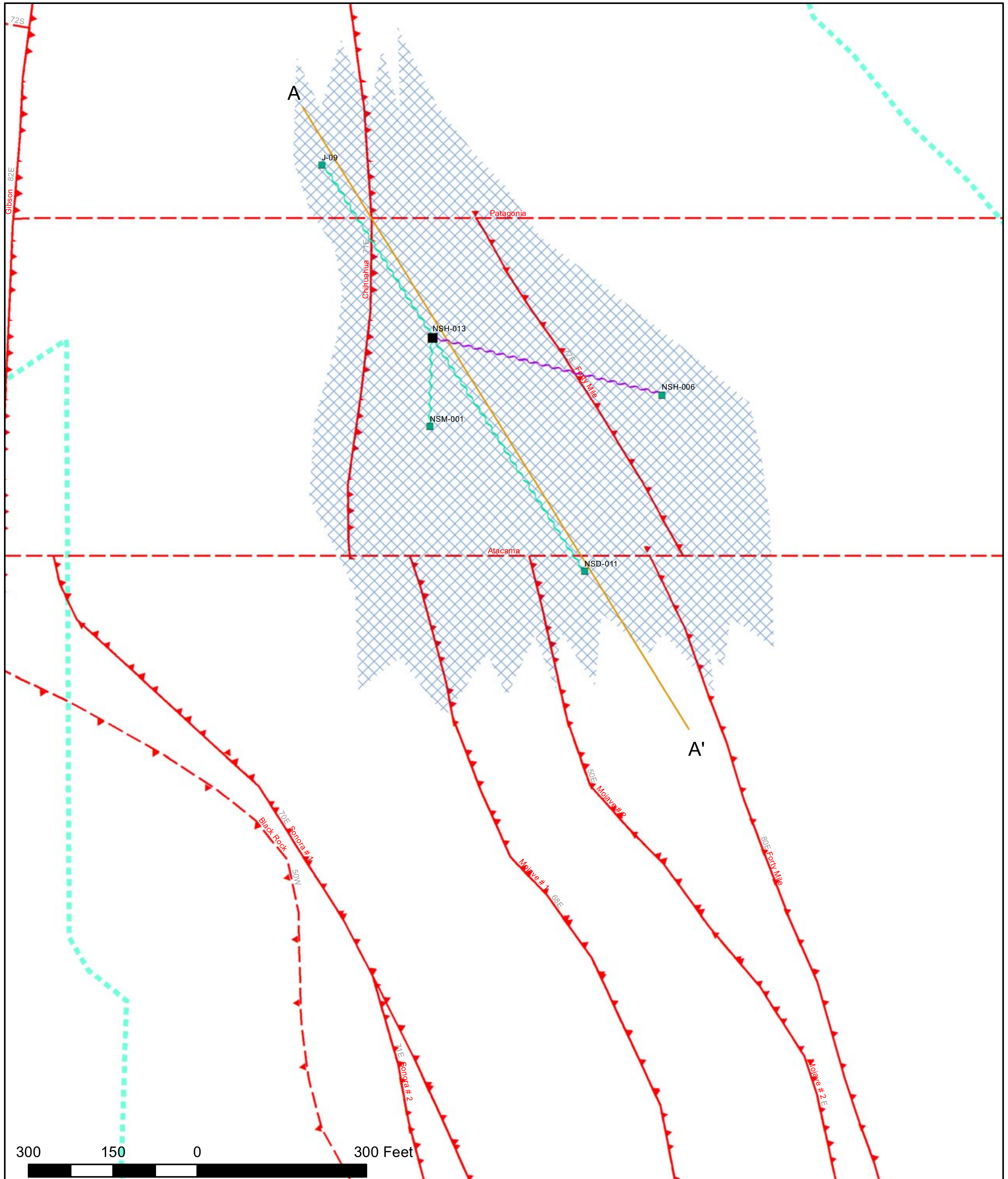
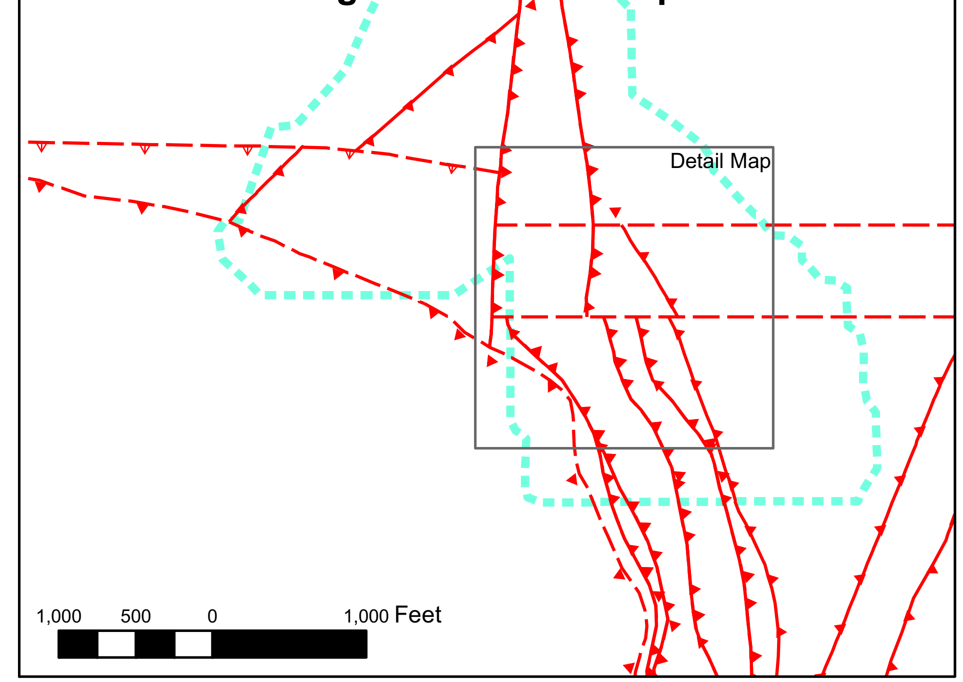
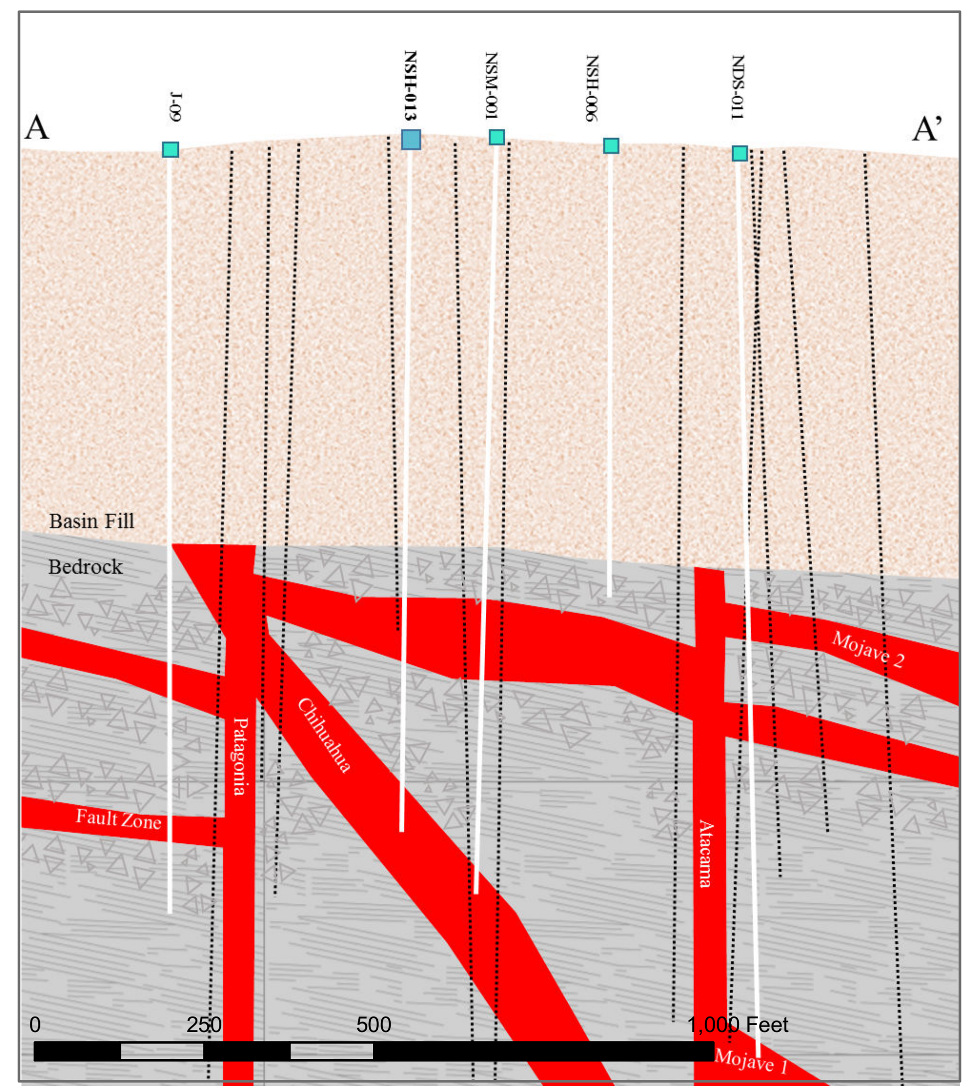
FIGURE A-8
Intermediate Monitor Well Network
Stage 1 and 2 Operations
Gunnison Copper Project



Regional Context Map



Cross Section NSH-013: A-A'



Legend

- Observation Well
- Pumping Well
- High Conductivity
- Moderate Conductivity
- Cross Section Line A-A'
- Aquifer Testing Area of Influence
- Approx Fault + Dip Direction (projected at bedrock surface)
- Wellfield Boundary
- Exploration Hole
- Fractured Wallrock

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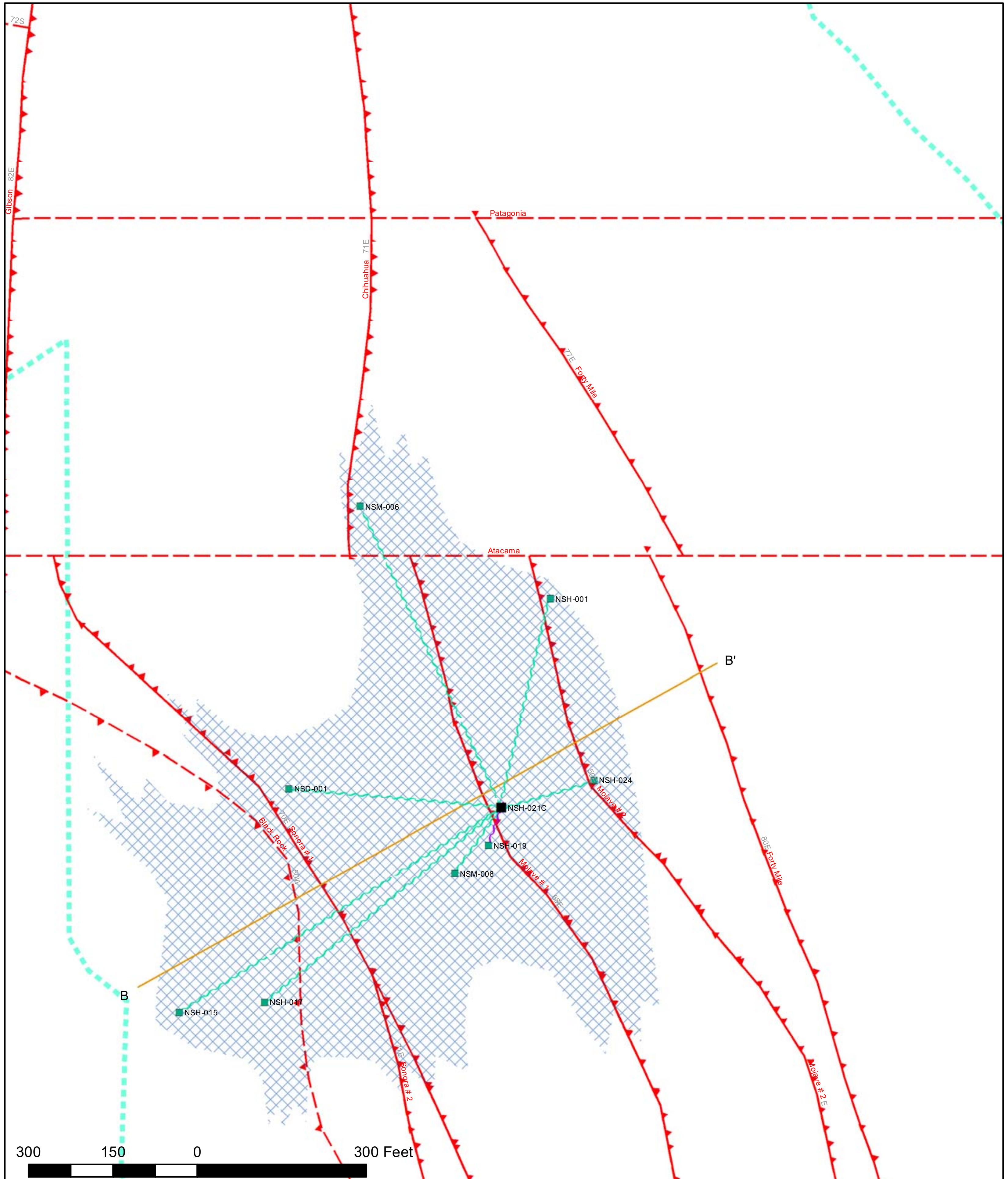
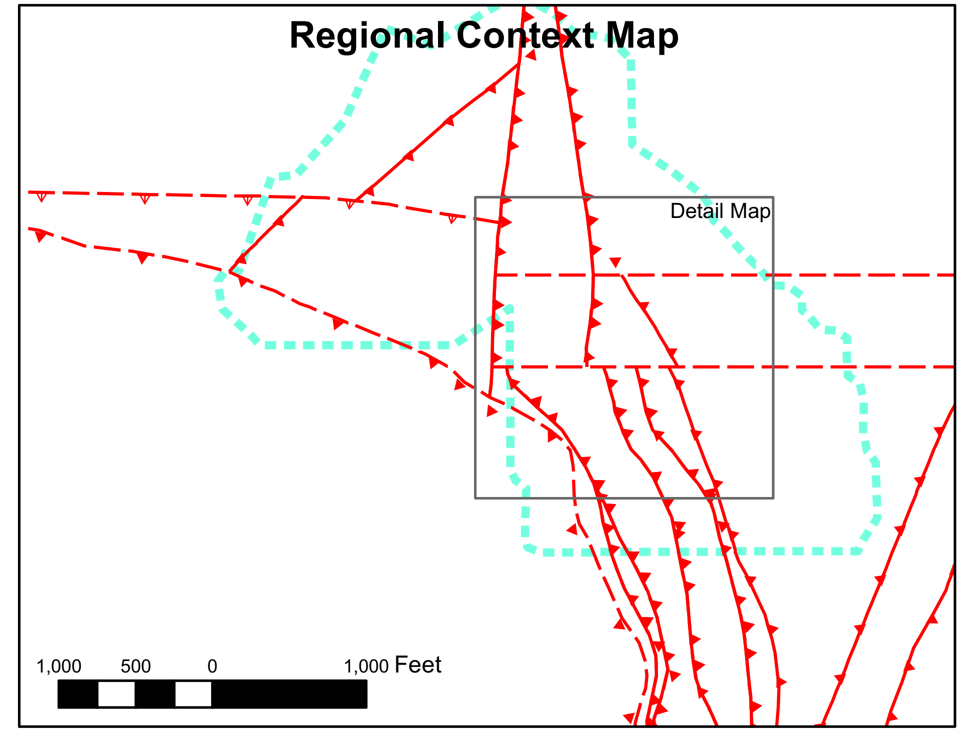
Gunnison Copper Project
Date Revised: 2/20/2017

Coordinate System: NAD 1983 StatePlane Arizona East FIPS 0201 Feet

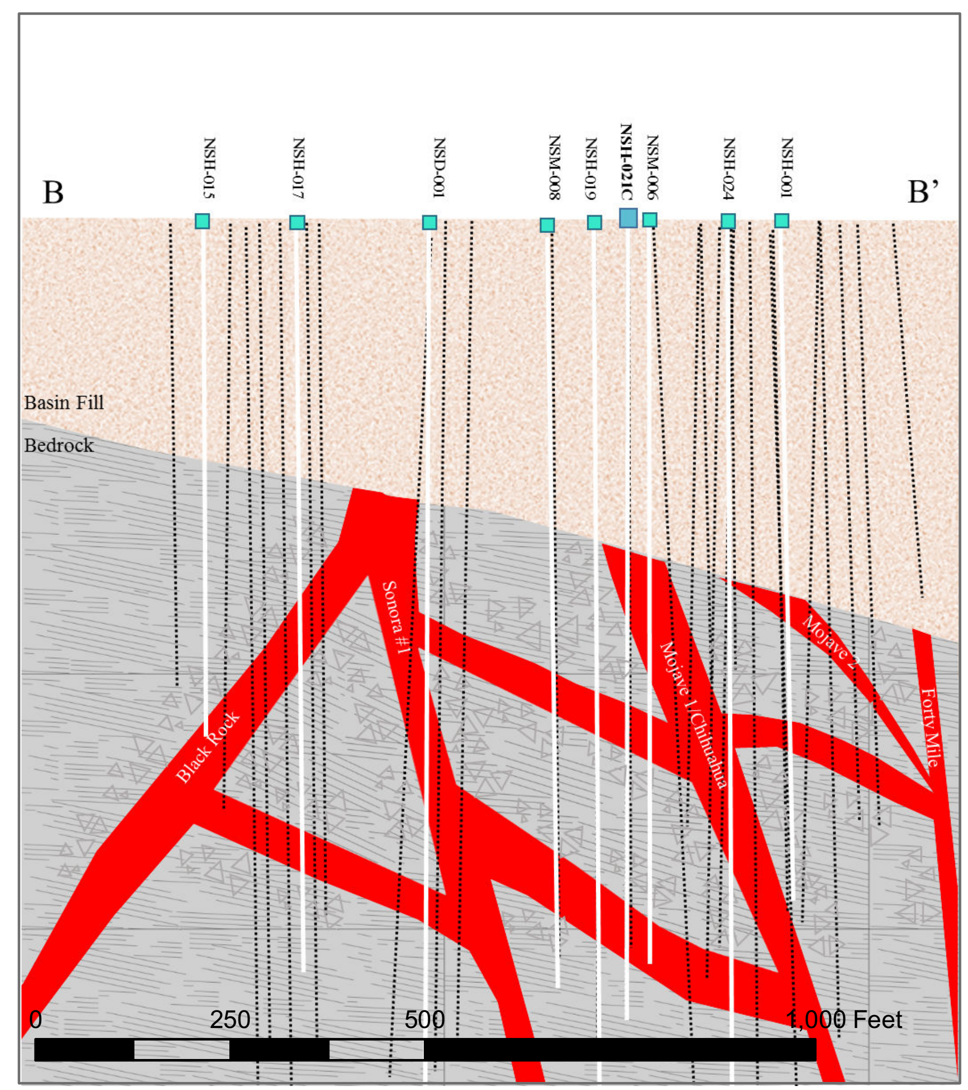
FIGURE A-9
AQUIFER TESTING AREA OF INFLUENCE NSH-013



Regional Context Map



Cross Section NSH-021C: B-B'



Legend

- Pumping Well
- Observation Well
- High Conductivity
- Moderate Conductivity
- Cross Section Line B-B'
- Aquifer Testing Area of Influence
- Approx Fault + Dip Direction (projected at bedrock surface)
- Wellfield Boundary
- Exploration Hole
- Fractured Wallrock

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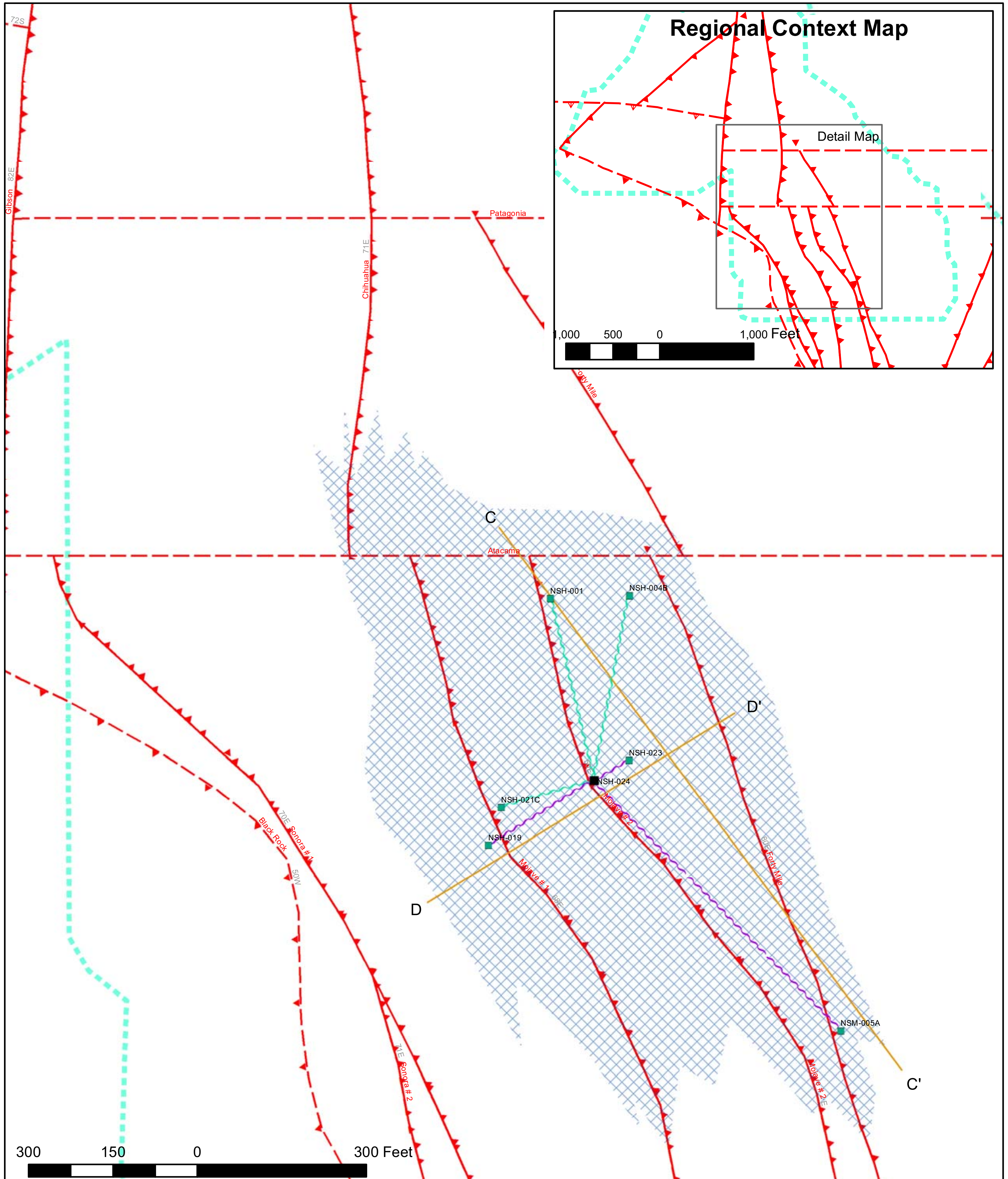
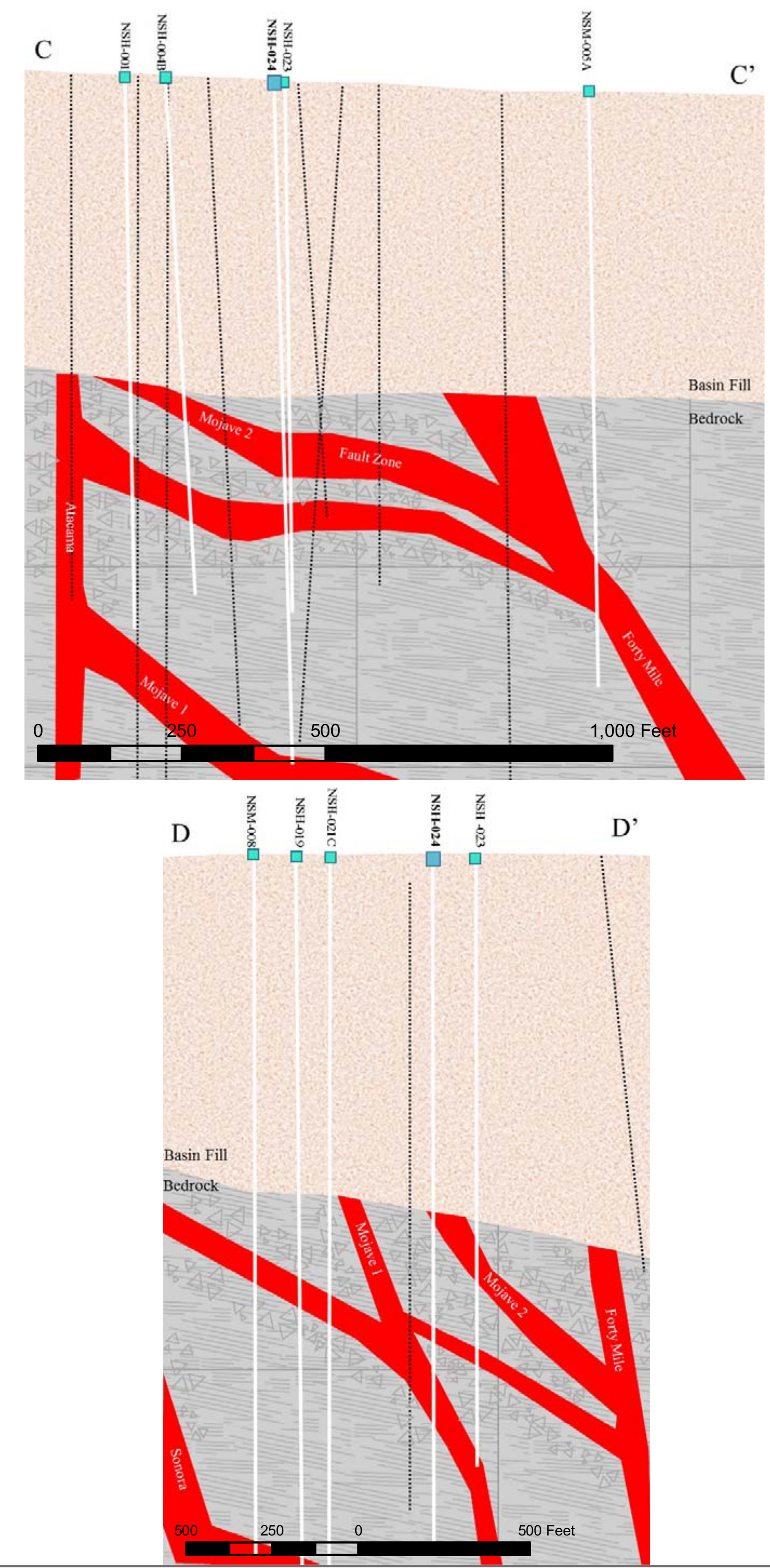
FIGURE A-10
AQUIFER TESTING AREA OF INFLUENCE NSH-021C



Cross Sections NSH-024: C-C' and D-D'



Legend

- Observation Well
- Pumping Well
- High Flow Strength
- Moderate Flow Strength
- Cross Section Lines C-C' and D-D'
- Section24Labels
- Aquifer Testing Area of Influence
- Approx Fault + Dip Direction (projected at bedrock surface)
- Wellfield Boundary
- Exploration Hole
- Fractured Wallrock

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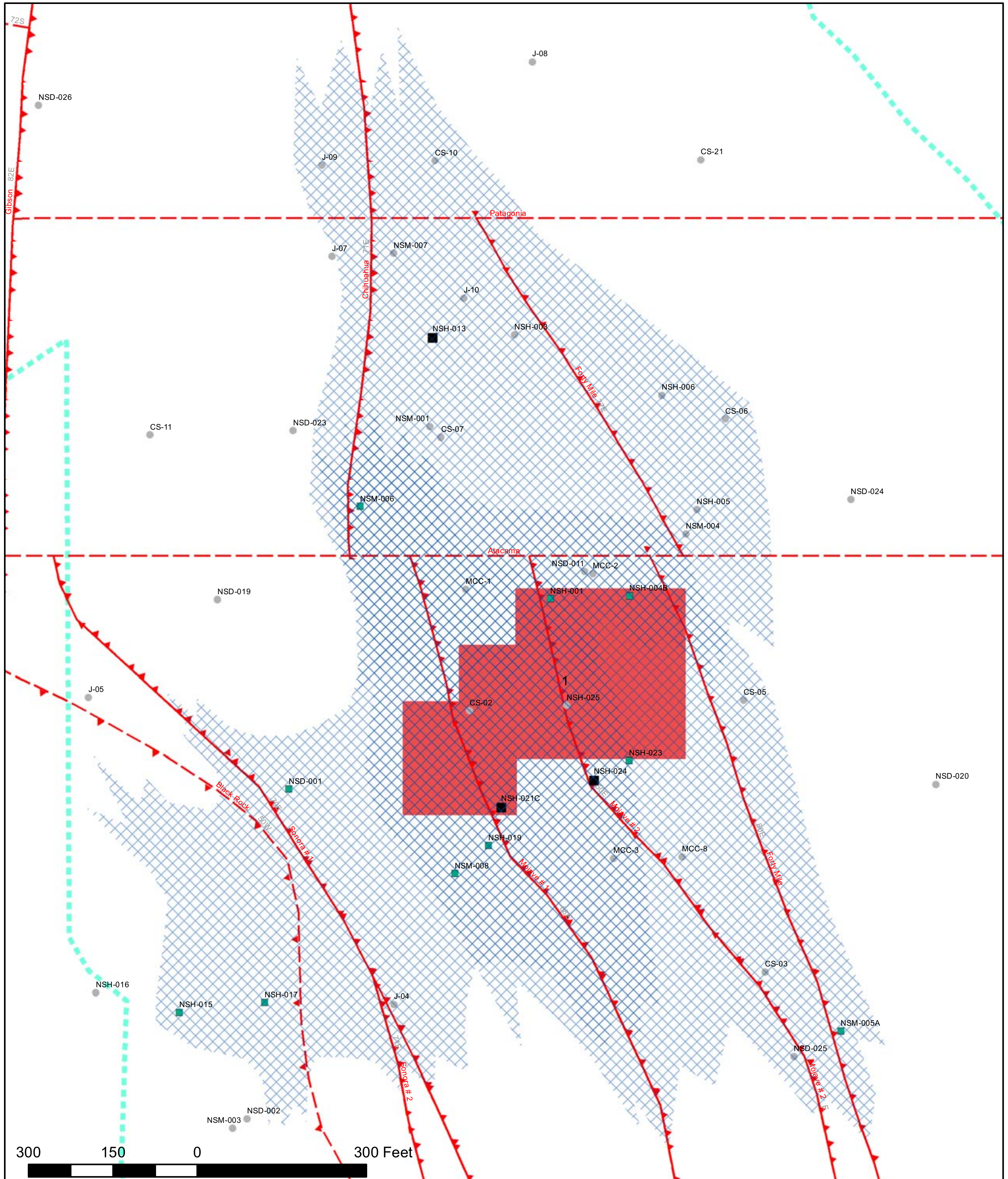
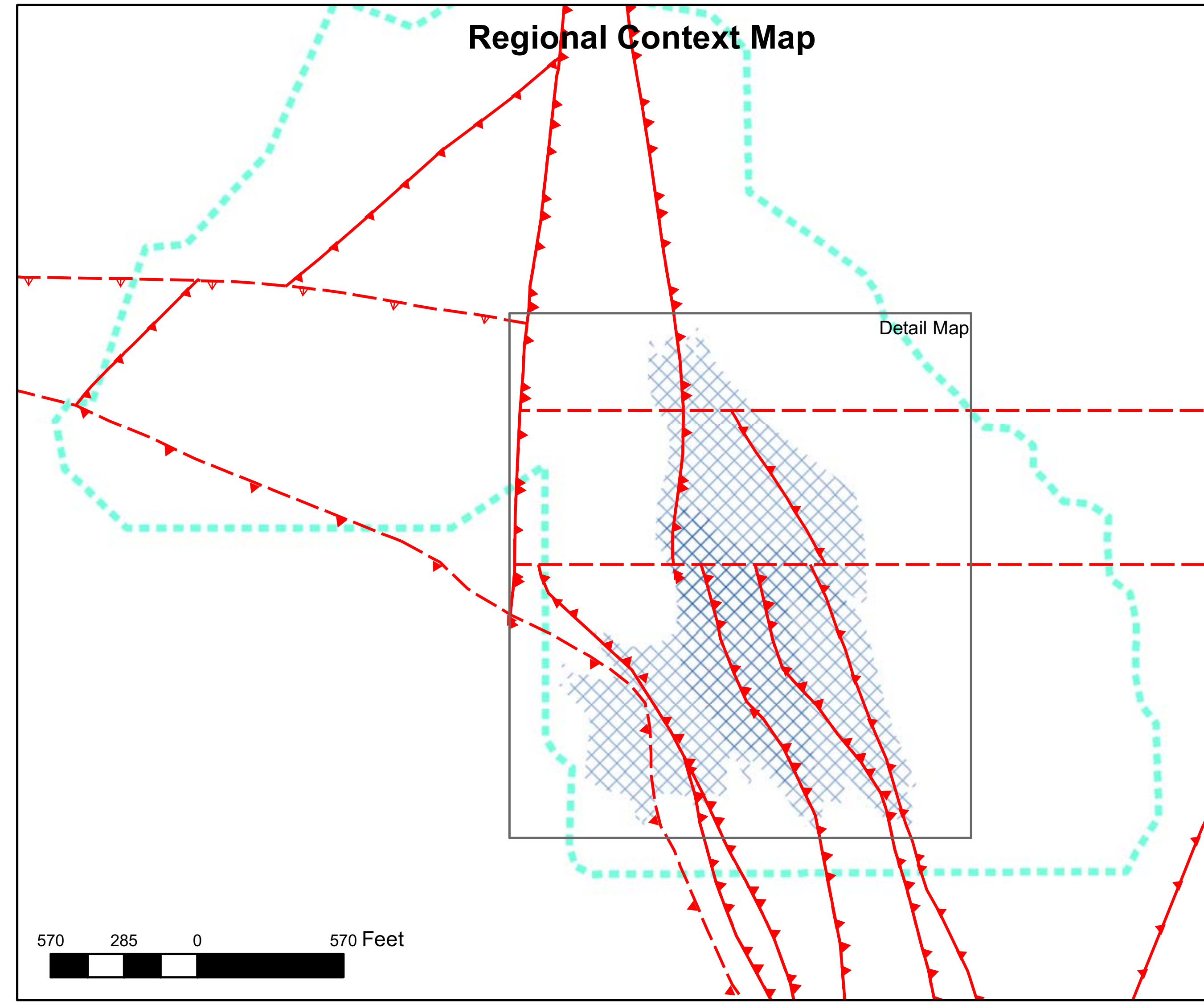
Gunnison Copper Project
Date Revised: 2/20/2017

Coordinate System: NAD 1983 StatePlane Arizona East FIPS 0201 Feet

FIGURE A-11
AQUIFER TESTING AREA OF INFLUENCE
NSH-024





Legend

- Exploration Hole
- Observation Well
- Pumping Well
- Approx Fault + Dip Direction (projected at bedrock surface)
- Wellfield Boundary
- Aquifer Testing Area of Influence

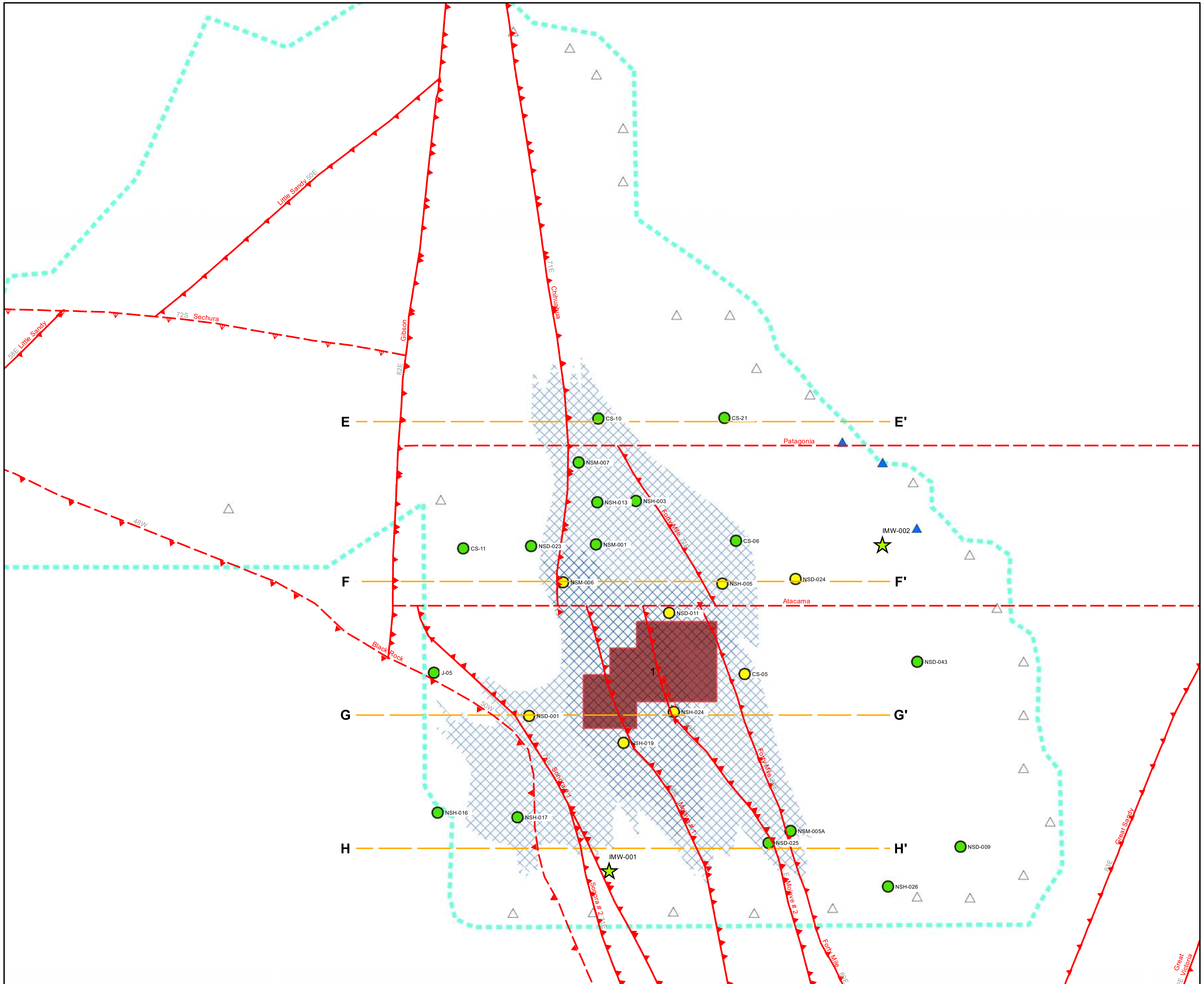
Production

- Year 1

Coordinate System:
NAD 1983
StatePlane Arizona
East FIPS 0201
Feet

Excelsior Mining Arizona Inc.
Gunnison Copper Project
Date Revised: 2/20/2017

FIGURE A-12
AQUIFER TESTING TOTAL AREA OF INFLUENCE: NSH-013, NSH-021C, NSH-024



Legend

Approx Fault + Dip Direction (projected at bedrock surface)

Cross Section Lines E - H

New IMW

Outer IMW

Inner IMW

Active HC Wells

Inactive HC Wells

Aquifer Test Influence Area

Wellfield Boundary

Production

Year 1

370 185 0 370 Feet

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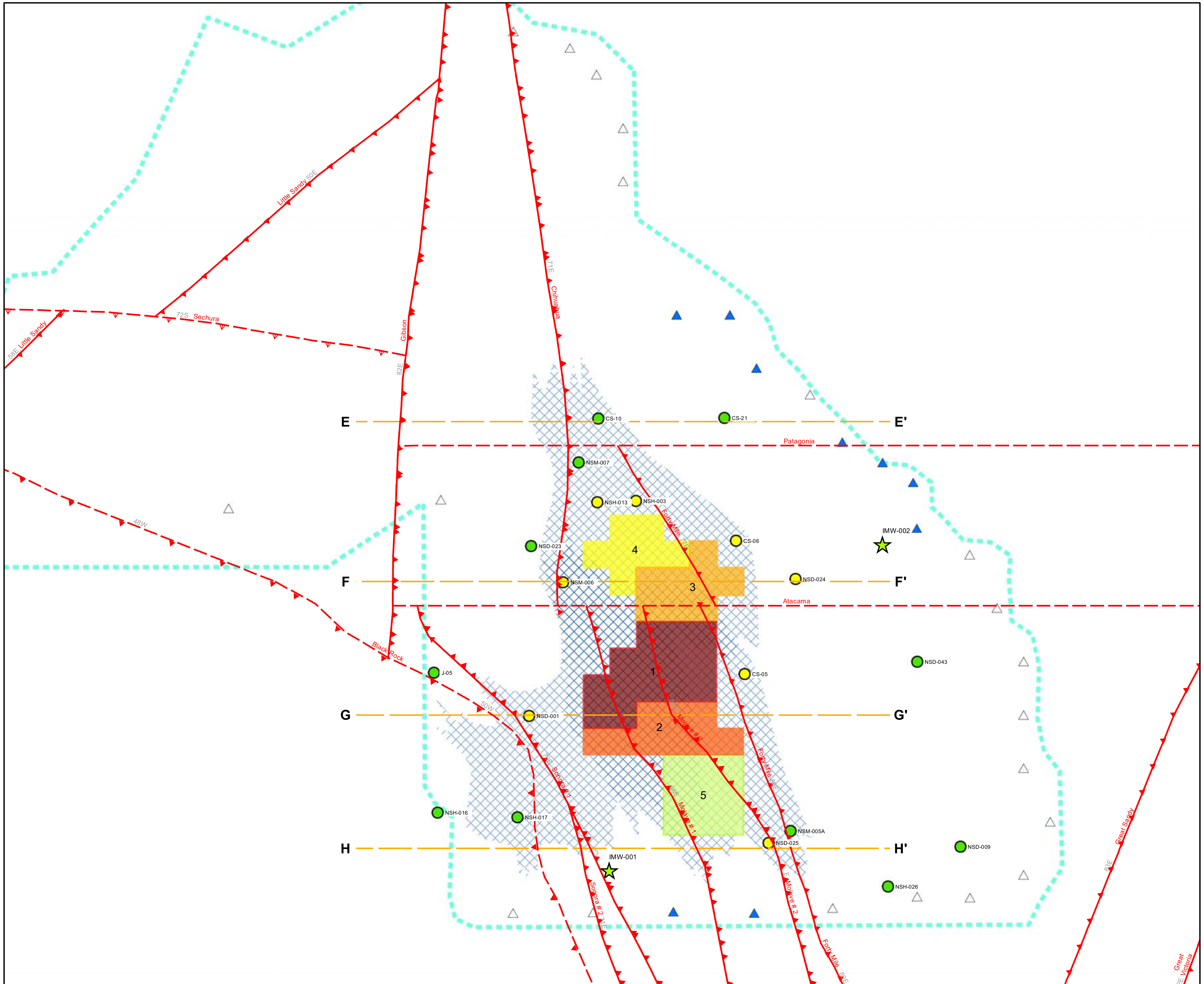
Excelsior Mining Arizona Inc.
Gunnison Copper Project
Date: 2/20/2017

Coordinate System: NAD 1983
StatePlane Arizona East FIPS 0201
Feet

FIGURE A-13
INTERMEDIATE MONITORING WELL LOCATIONS: YEAR 1



Legend

Approx Fault + Dip Direction (projected at bedrock surface)

Cross Section Lines E - H

New IMW

Active HC Wells

Inactive HC Wells

Outer IMW

Inner IMW

Aquifer Test Influence Area

Wellfield Boundary

Production

Year 1

Year 2

Year 3

Year 4

Year 5

370 185 0 370 Feet

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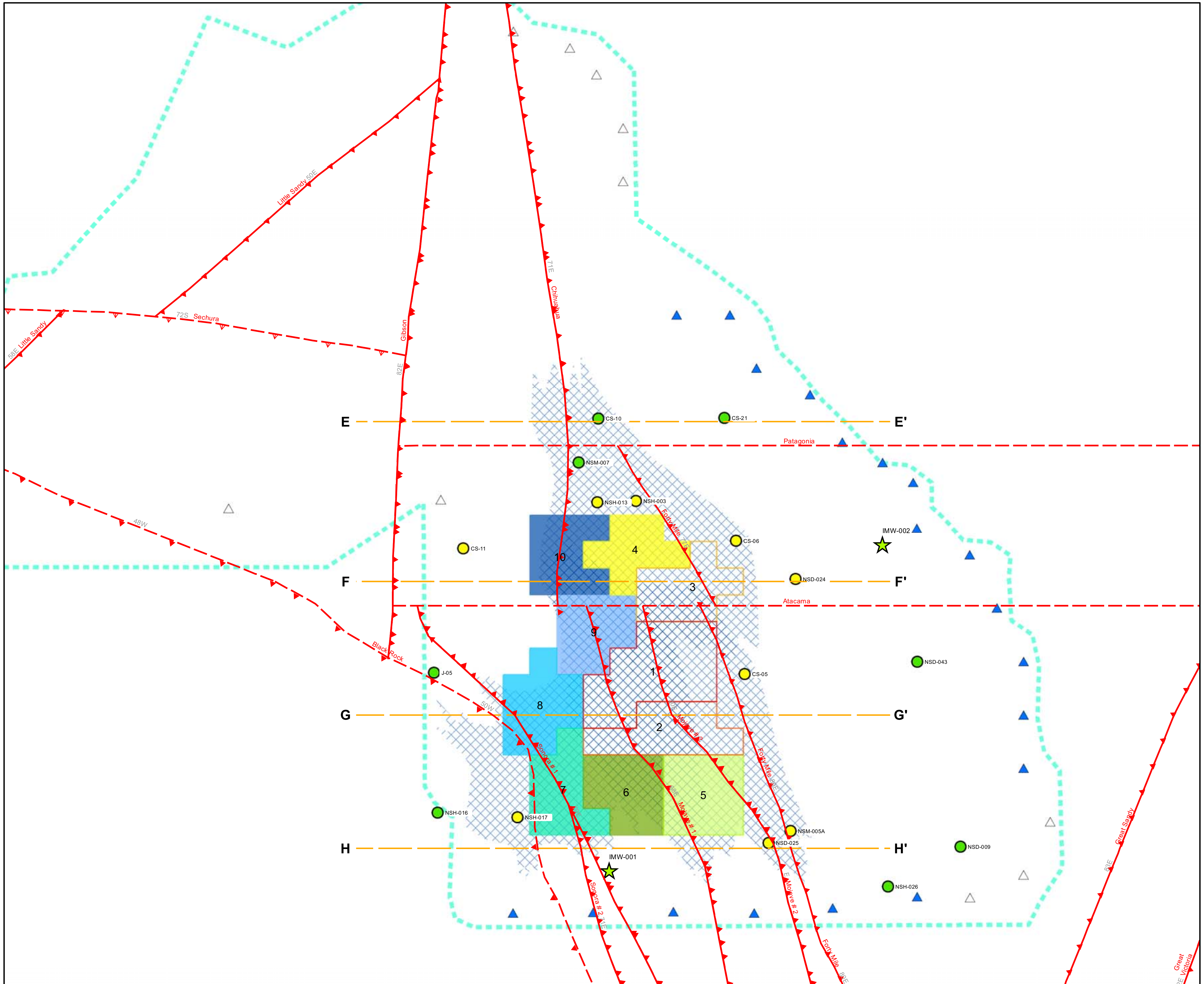
Gunnison Copper Project
Date: 2/20/2017

Coordinate System: NAD 1983
StatePlane Arizona East FIPS 0201
Feet

FIGURE A-14
INTERMEDIATE MONITORING WELL LOCATIONS: YEAR 5



Legend

Approx Fault + Dip Direction (projected at bedrock surface)

Cross Section Lines E - H

New IMW

Outer IMW

Inner IMW

Active HC Wells

Inactive HC Wells

Aquifer Test Influence Area

Wellfield Boundary

Production

Year 1 (Rinsed)

Year 2 (Rinsed)

Year 3 (Rinsed)

Year 4

Year 5

Year 6

Year 7

Year 8

Year 9

Year 10

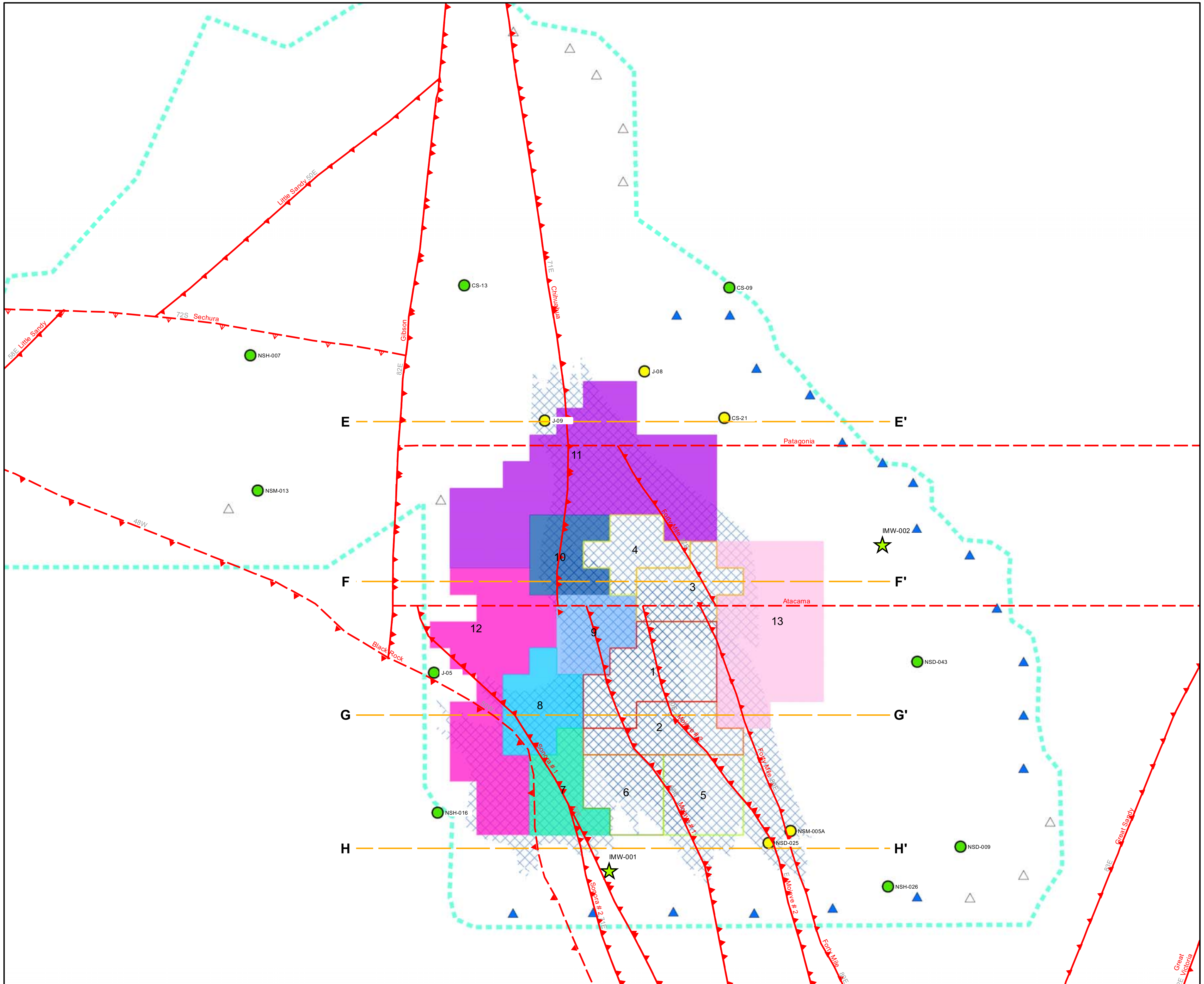
370 185 0 370 Feet

Excelsior MINING CORP

Excelsior Mining Arizona Inc.
Gunnison Copper Project
Date: 2/20/2017

Coordinate System: NAD 1983
StatePlane Arizona East FIPS 0201
Feet

FIGURE A-15
INTERMEDIATE MONITORING WELL LOCATIONS: YEAR 10



Legend

Approx Fault + Dip Direction (projected at bedrock surface)

Cross Section Lines E - H

New IMW

Outer IMW

Inner IMW

Active HC Wells

Inactive HC Wells

Aquifer Test Influence Area

Wellfield Boundary

Production

Year 1 (Rinsed)

Year 2 (Rinsed)

Year 3 (Rinsed)

Year 4 (Rinsed)

Year 5 (Rinsed)

Year 6 (Rinsed)

Year 7

Year 8

Year 9

Year 10

Year 11

Year 12

Year 13

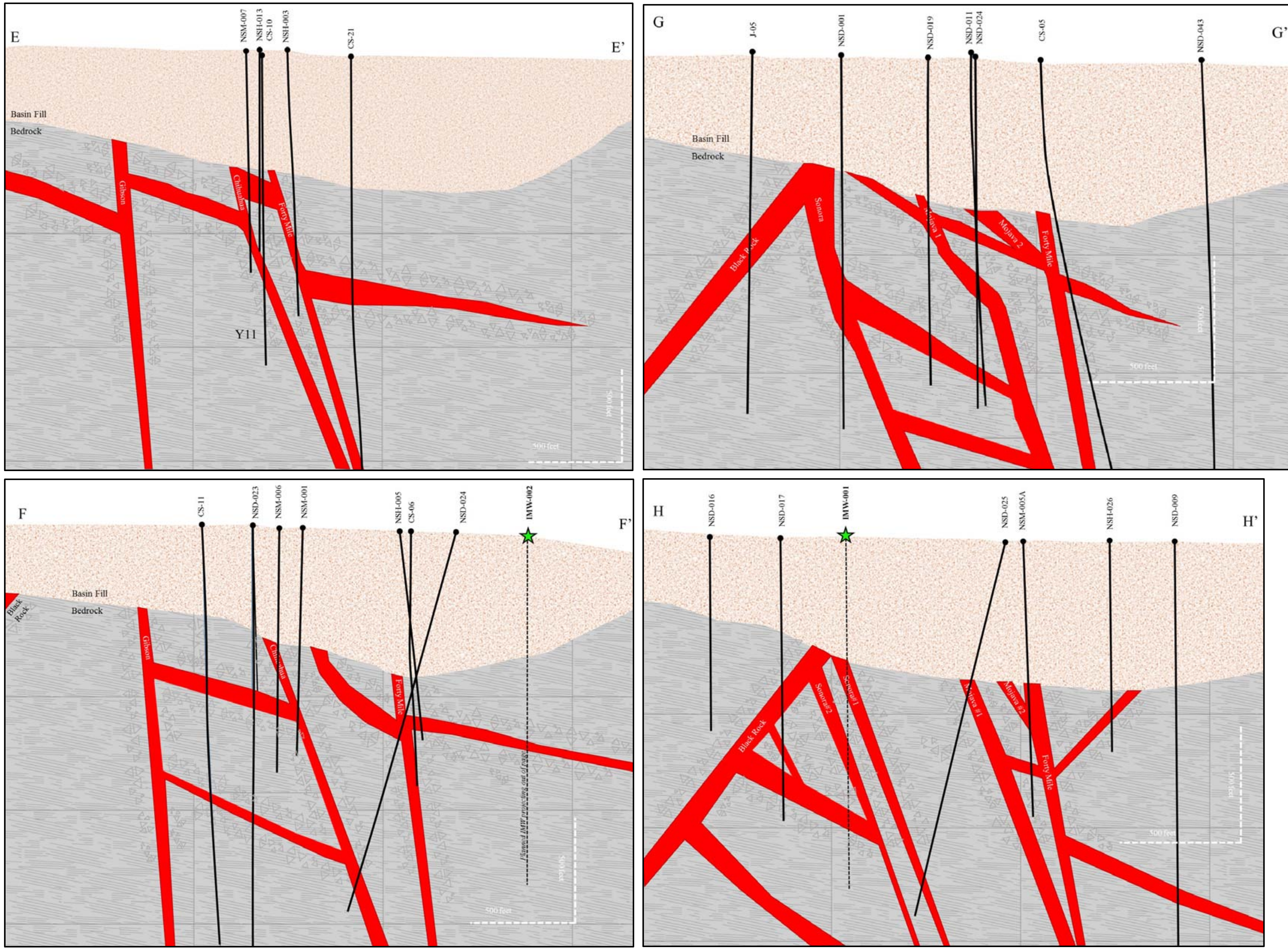
370 185 0 370 Feet

Excelsior MINING CORP

Excelsior Mining Arizona Inc.
Gunnison Copper Project
Date: 2/20/2017

Coordinate System: NAD 1983
StatePlane Arizona East FIPS 0201
Feet

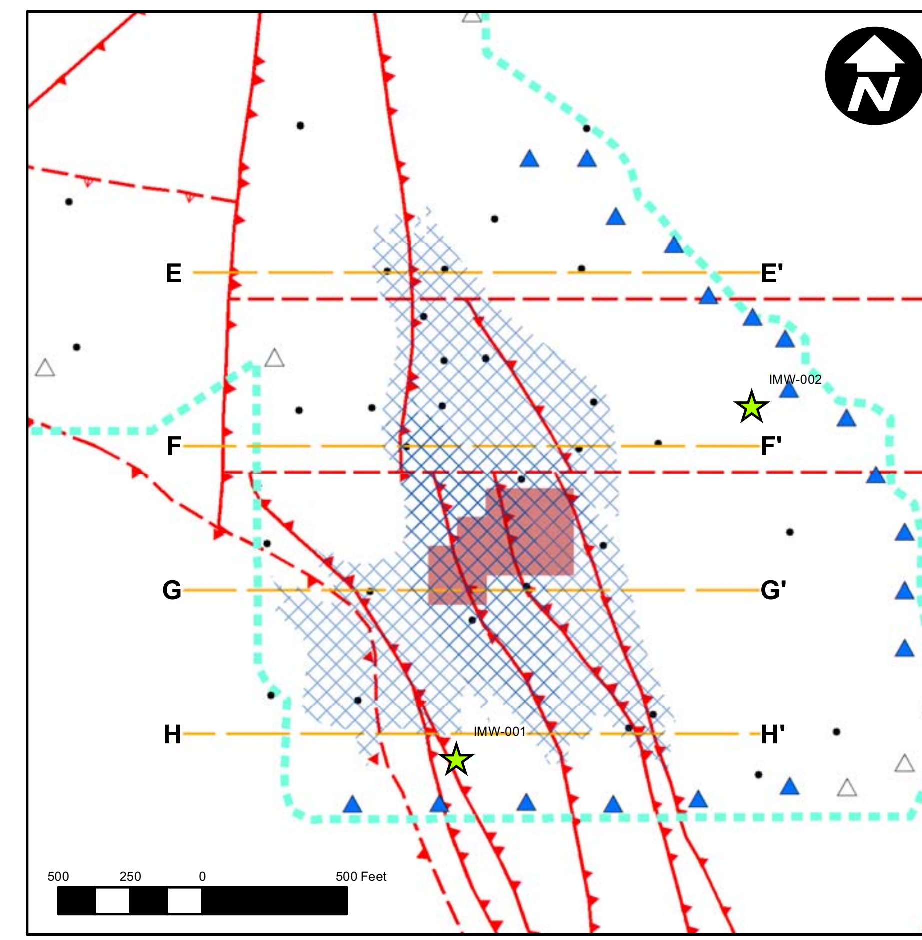
FIGURE A-16
INTERMEDIATE MONITORING WELL LOCATIONS: YEAR 13



Excelsior MINING CORP

Excelsior Mining Arizona Inc.
Gunnison Copper Project
Date Revised: 2/20/2017

Coordinate System: NAD 1983 StatePlane
Arizona East FIPS 0201 Feet

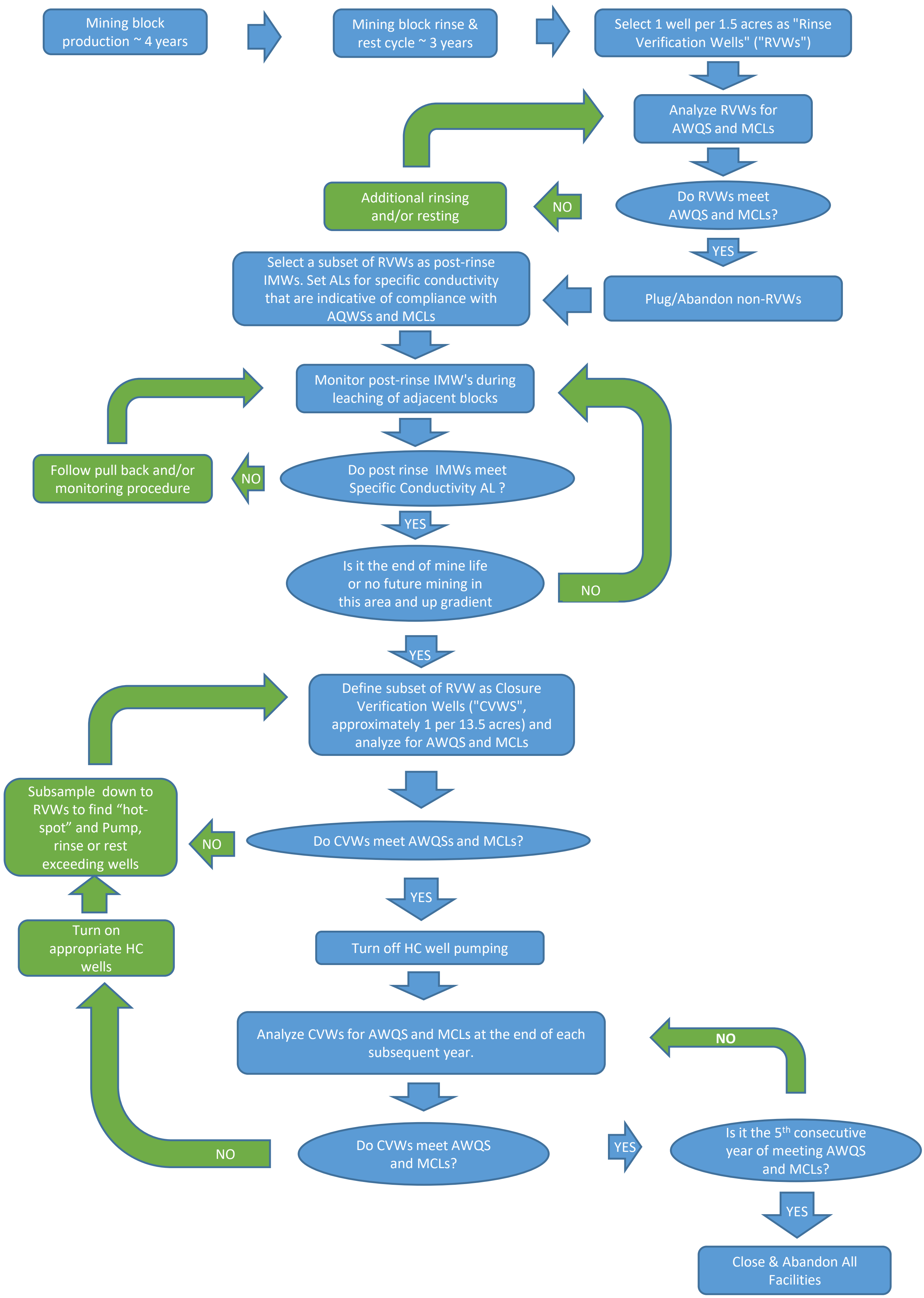


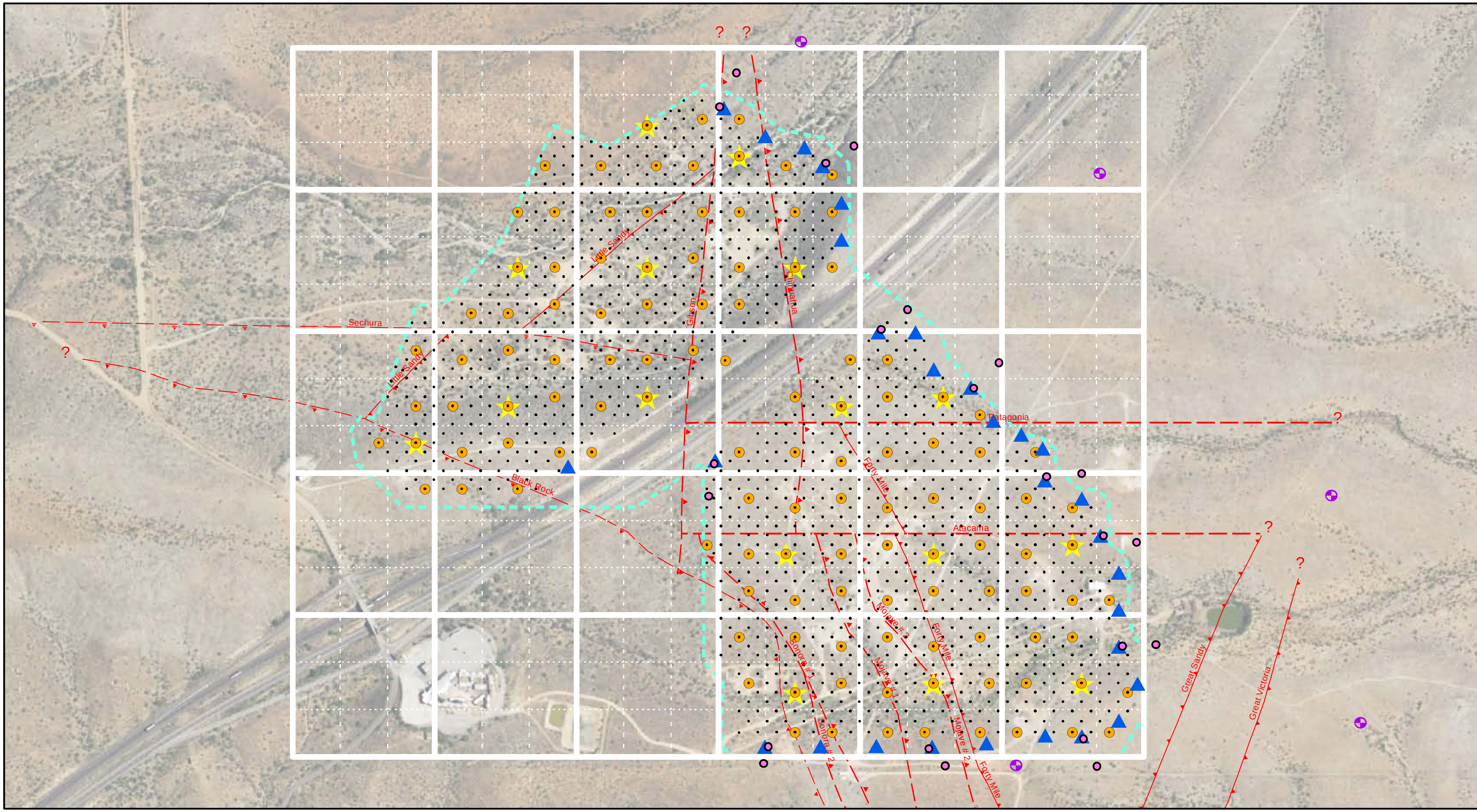
Legend

- New IMW
- IMW
- Pump Test Influence
- Wellfield Boundary
- Cross Section Lines E - H
- Active HC Wells
- Inactive HC Wells
- Approx Fault + Dip Direction (Faults projected at bedrock surface)
- **Production**
- Year 1
- Overburden
- Bedrock
- Fault Zone
- Fractured Bedrock
- IMW
- New IMW

FIGURE A-17
INTERMEDIATE MONITORING WELL LOCATIONS - CROSS SECTIONS E-F

FIGURE A-18: Closure Strategy Decision Tree





HC Observation Wells

Wellfield POC Wells

HC Well

Production Well

RVW

CVW

13.5 acres

1.5 acres

Wellfield Boundary

1,000 500 0 1,000 Feet

Excelsior MINING CORP

Excelsior Mining Arizona Inc.
Gunnison Copper Project
Date Revised: 2/21/2017

N

Coordinate System: NAD 1983 StatePlane Arizona East FIPS 0201 Feet

FIGURE A-19 **CLOSURE AND POST-CLOSURE MONITORING LOCATIONS**

Table A-1:Intermediate Monitoring Well Activity by Production Year

Intermediate Monitoring Well Activity By Production

Generated 2/8/2017

								IMW Activity by Production Year																	
								O	Outer IMW			I	Inner IMW			A	IMW Year Abandoned								
	HOLEID	Azimuth	Dip	Collar Elevation (ft)	Depth (ft)	Lat	Long	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Screened	Screen Depth From (ft)	Screen Depth To (ft)
1	**NSH-019**	**0**	**-90**	4813.772	1410	32.0815879°	-110.0478899°	I	A														Open Hole	638	1410
2	**NSH-024**	**0**	**-90**	4819.07	1445	32.0819062°	-110.0428590°	I	A														Open Hole	625	1445
3	**NSD-011**	**0**	**-90**	4834.35	1438	32.0829234°	-110.0429125°	I	I	A													N	645	1438
4	**NSH-005**	**0**	**-90**	4829.83	1040	32.0832251°	-110.0422664°	I	I	A													Y	747	1019
5	**NSM-001**	**0**	**-90**	4850.525	1150	32.0836335°	-110.0437963°	O	O	I	A												N	575	1150
6	**NSD-001**	**0**	**-90**	4827.17	1506	32.0818639°	-110.0446091°	I	I	I	I	I	I	I	A								N	458	1506
7	**NSD-023[#]**	**180**	**-70**	4857.306	1546	32.0836150°	-110.0445842°	O	O	O	O	O	O	O	O	I	A						N	557	1546
8	**NSM-006**	**0**	**-90**	4847.479	1217	32.0832435°	-110.0441972°	I	I	I	I	I	I	I	I	I	A						N	541	1217
9	**CS-10**	**0**	**-90**	4828.54	1656	32.0849309°	-110.0437687°	O	O	O	O	O	O	O	O	O	O	A					N	730	1656
10	**CS-11**	**0**	**-90**	4863.12	2084	32.0835938°	-110.0454011°	O	O	O	O	O	O	O	O	O	I	A					N	481	2084
11	**NSH-003**	**0**	**-90**	4846.072	1432	32.0840811°	-110.0478867°	O	O	O	I	I	I	I	I	I	I	A					Y	1232	1399
12	**NSH-013**	**0**	**-90**	4850.415	1070	32.0840678°	-110.0437796°	O	O	I	I	I	I	I	I	I	I	A					Open Hole	650	1070
13	**NSM-007**	**0**	**-90**	4844.188	1168	32.0844803°	-110.0440050°	O	O	O	O	O	O	O	O	O	O	A					N	600	1168
14	**NSH-017**	**0**	**-90**	4806.813	1181	32.0808222°	-110.0447493°	O	O	O	O	O	O	I	I	I	I	I	A				Y	940	1181
15	**CS-05**	**0**	**-90**	4817.75	2034	32.0822957°	-110.0419996°	I	I	I	I	I	I	I	I	I	I	I	I	A			N	645	2034
16	**CS-06**	**0**	**-90**	4831.4	2160	32.0836703°	-110.0421043°	O	O	I	I	I	I	I	I	I	I	I	I	A			N	718	2160
17	**NSD-024[#]**	**270**	**-70**	4823.291	1972	32.0832737°	-110.0413848°	I	I	I	I	I	I	I	I	I	I	I	I	A			N	750	1972
17.5	***IMW-001****	***270***	***-70***	4798	1600*	32.0802743°	-110.0436410°	O	O	O	O	O	O	O	O	O	O	O	O	O	A		N (?)	*600 (approx)*	*1600 (approx)*
18	**NSD-009**	**0**	**-90**	4788.19	1793	32.0805145°	-110.0393900°	O	O	O	O	O	O	O	O	O	O	O	O	O	A		N	620	1793
19	**NSD-025[#]**	**270**	**-70**	4789.8	1644	32.0805525°	-110.0417146°	O	O	O	O	I	I	I	I	I	I	I	I	I	A		N	637	1644
20	**NSH-026**	**0**	**-90**	4794.091	905	32.0819062°	-110.0428590°	O	O	O	O	O	O	O	O	O	O	O	O	O	A		Open Hole	625	905
21	**NSM-005A**	**0**	**-90**	4786.902	1172	32.0806787°	-110.0414465°	O	O	O	O	O	O	I	I	I	I	I	I	I	A		N	592	1172
22	**CS-21**	**0**	**-90**	4809.94	2171	32.0849350°	-110.0422414°	O	O	O	O	O	O	O	O	O	O	I	I	I	I	A	N	688	2171
23	**NSD-043**	**0**	**-90**	4802.365	1736	32.0824201°	-110.0399104°	O	O	O	O	O	O	O	O	O	O	O	O	O	O	A	N	630	1736
23.5	***IMW-002*[#]***	***180***	***-70***	4800	1600*	32.0836339°	-110.0403275°	O	O	O	O	O	O	O	O	O	O	O	O	O	O	A	N (?)	*750 (approx)*	*1600 (approx)*
24	**J-05**	**0**	**-90**	4836.75	1475	32.0823131°	-110.0457580°	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	N	415	1475
25	**NSH-016**	**0**	**-90**	4812.227	820	32.0808698°	-110.0457147°	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Y	301	701
26	**CS-09**	**0**	**-90**	4832.68	2337	32.0862792°	-110.0421815°												O	O	O	O	N	685	2337
27	**CS-13**	**0**	**-90**	4767.88	1251	32.0863042°	-110.0453846°												O	O	O	O	N	462	1251
28	**NSH-007**	**0**	**-90**	4773.177	620	32.0855837°	-110.0479752°												O	O	O	O	Y	536	616
29	**NSM-013**	**0**	**-90**	4881.136	953	32.0841926°	-110.0478866°												O	O	O	O	N	405	953
30	**J-08**	**0**	**-90**	4810.4	1350	32.0854170°	-110.0432095°													I	I	I	N	661	1350
31	**J-09**	**0**	**-90**	4824.4	1158	32.0849096°	-110.0444145°													I	I	I	N	591	1158
34	** indicates planned IMW*																								
	[#] indicates angled IMW																								

Table A-2: Intermediate Monitoring Well Structures

	Structure	NSH-017	NSD-001	NSD-025	IMW-001	NSH-016	NSH-024	NSD-011	NSM-005A	CS-05	CS-06	NSH-005	NSH-026	IMW-002	NSD-023	NSD-024	NSM-001	NSM-006	NSH-013	CS-10	NSM-007	CS-21	J-08	NSM-013	NSH-007	CS-11	CS-13	NSH-019	J-05	NSD-009	NSH-003	NSD-043	CS-09	J-09
1	**Black Rock**	1	2	2	2	1																												
2	***Bedding Parallel 840***	2	2	2	2	2																												
3	***Bedding Parallel 842***	1	2	2	2	2																												
4	***Bedding Parallel 843***	2	2	2	2	2																												
5	***Bedding Parallel 844***	2	1	2	2	2																												
6	**Sonora #1 & 2**		1	1	1		2								2													2						
7	***Bedding Parallel 823***		2				1								1		2	2	2	2	2					1	1	1						
8	***Bedding Parallel 845***		2	2	2		2																											
9	***Bedding Parallel 846***		2	2	2		2																											
10	***Bedding Parallel 848***		2	2	2		2																											
11	***Bedding Parallel 852***		2	2	2		2																					1						
12	**Mojave #1**			1			1	2	2																			2						
13	***Bedding Parallel 858***			2			1	1	2					2		2																		
14	***Bedding Parallel 856***			2			2	2	1					2		2																		
15	**Mojave #2**						1	1	2					2		2																		
16	**Forty Mile**						2	2	1	2	2	2	2	1		1	2													2				
17	***Bedding Parallel 828***								2	2	2	2	2	2	2	2	2													1				
18	***Bedding Parallel 826***								2	2	2	2	1		2	2	2																	
19	**BP 827**								2	1	1	1			2	2	2																	
20	**Atacama**														1	1	2	2	2															
21	**Chihuahua**														2		1	1	1															
22	***Bedding Parallel 837***																2	2	2															
23	**Gibson**														2		2	2	2						2	2	2							
24	***Bedding Parallel 823***		2				1								1		2	2	2	2	2					1	1	1						
25	***Bedding Parallel 860***																2	2	2	2	2													
26	**Chihuahua**																1	1	1	1	1	2	2											
27	***Bedding Parallel 825***																2	2	2	2	2	1	1											
28	***Bedding Parallel 824***																1	2	1	1	1		1											
29	**Patagonia**																			2	2	2	2	2										
30	***Bedding Parallel 822***																							1	2									
31	**Sechura**													1										2	1									
32	**Little Sandy**													2										2	2									

Indicates Direct Drill Hole Intersection with Specified Structure 1

Indicates Secondary Connection with Specified Structure 2

***Each of the proposed wells intercepts at least one large structure and numerous small and secondary structures**